(12)

NSWCDD/TR-92/160

HYPERVELOCITY TUNNEL 9 MACH 10/14 CALIBRATION

BY DAN MARREN

STRATEGIC AND SPACE SYSTEMS DEPARTMENT

31 JANUARY 1994

Approved for public release; distribution is unlimited.

NSWC
Naval Surface Warfare Center
DAHLGREN DIVISION

NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION • WHITE OAK DETACHMENT
Silver Spring, Maryland 20903-5640

NSWCDD/TR-92/160

HYPERVELOCITY TUNNEL 9 MACH 10/14 CALIBRATION

BY DAN MARREN
STRATEGIC AND SPACE SYSTEMS DEPARTMENT

31 JANUARY 1994

NAVAL SURFACE WARFARE CENTER
DAHLGREN DIVISION • WHITE OAK DETACHMENT
Silver Spring, Maryland 20903-5640

FOREWORD

This report documents the Mach 10/14 Calibration test program (WTR 1608) performed in the Naval Surface Warfare Center White Oak Detachment (NSWCWODET) Hypervelocity Tunnel 9. The National Aerospace Plane Joint Project Office (NASP JPO) was the sponsor for this test entry. The primary objective for this test program was to supplement previous calibrations of the NSWCWODET Tunnel 9 free stream conditions.

Approved by:

R. L. Schmidt

R. L. SCHMIDT, Head
Strategic and Space Systems Department

ABSTRACT

This report documents the Tunnel 9 Mach 10/14 Calibration test program (WTR 1608) performed at the Naval Surface Warfare Center, White Oak, Maryland. This effort was sponsored by the National Aerospace Plane Joint Program Office (NASP JPO). Free stream flow field parameter distributions were obtained for both the Mach 10 and 14 nozzles spanning the Reynolds number range. A total of four Mach 10, and ten Mach 14 runs were performed during this test program. The test period was 7 to 22 May 1991. Results from this test entry were combined with previous test data in the final analysis. Data from the test reveal that high quality uniform flow exists and that deviations in core flow field parameters are comparable with the calibration data taken in the past.

CONTENTS

	Page
INTRODUCTION	1
TEST FACILITY	1
TEST HARDWARE	2
INSTRUMENTATION	2
TUNNEL INSTRUMENTATION	2
PITOT RAKE INSTRUMENTATION	2
CALIBRATION AND TEST PROCEDURES	2
PRESSURE TRANSDUCER CALIBRATION	2
RUN SETUP AND INITIATION	3
DATA ACQUISITION AND REDUCTION	3
DIGITAL FILTERS	3
MEASUREMENT UNCERTAINTY	3
RESULTS	4
PRESENTATION OF RESULTS	4
TEMPORAL UNIFORMITY	4
RADIAL SYMMETRY	5
RUN REPEATABILITY	5
COMBINING CALIBRATION RESULTS WITH TEST DATA	5
MACH 10 SPATIAL UNIFORMITY	6
DEVIATION OF PITOT PRESSURE WITH REYNOLDS NUMBER	6
FIRST WINDOW STATION	6
DEVIATIONS OF PITOT PRESSURE WITH AXIAL POSITION	6
REYNOLDS NUMBER = 20×10^6/FT	6
MACH 14 SPATIAL UNIFORMITY	6
DEVIATIONS OF PITOT PRESSURE WITH REYNOLDS NUMBER	6
FIRST WINDOW STATION	6
SECOND WINDOW STATION	6
THIRD WINDOW STATION	6
DEVIATIONS OF PITOT PRESSURE WITH AXIAL POSITION	7
REYNOLDS NUMBER = 4.0×10^6/FT	7
REYNOLDS NUMBER = 2.0×10^6/FT	7
REYNOLDS NUMBER = 0.5×10^6/FT	7
REYNOLDS NUMBER = 0.1×10^6/FT	7

CONTENTS (Continued)

	Page
SUMMARY	7
REFERENCES	25
GLOSSARY	27
APPENDIX A—FREE STREAM FLOW FIELD PARAMETERS FOR ALL NOMINAL TEST CONDITIONS	A-1
DISTRIBUTION	(1)

ILLUSTRATIONS

Figure		Page
1	NSWCWODET HYPERVELOCITY WIND TUNNEL 9	8
2	TUNNEL 9 CALIBRATION SETUP	9
3	TUNNEL 9 CALIBRATION STATIONS	10
4	TUNNEL 9 SUPPLY CONDITIONS	11
5	TUNNEL 9 TEMPORAL UNIFORMITY	12
6	COMPARISON OF HORIZONTAL AND VERTICAL PROFILES	12
7	COMPARISON OF RUN REPEATABILITY	12
8	MACH 10 NORMALIZED PITOT PROFILES AT FIRST WINDOW STATION	13
9	MACH 10 NORMALIZED PITOT PROFILES AT REYNOLDS # = 20 MILLION/FT	14
10	MACH 14 NORMALIZED PITOT PROFILES AT FIRST WINDOW STATION	15
11	MACH 14 NORMALIZED PITOT PROFILES AT SECOND WINDOW STATION	16
12	MACH 14 NORMALIZED PITOT PROFILES AT THIRD WINDOW STATION	17
13	MACH 14 NORMALIZED PITOT PROFILES AT REYNOLDS # = 4 MILLION/FT	18
14	MACH 14 NORMALIZED PITOT PROFILES AT REYNOLDS # = 2 MILLION/FT	19
15	MACH 14 NORMALIZED PITOT PROFILES AT REYNOLDS # = 0.5 MILLION/FT	20
16	MACH 14 NORMALIZED PITOT PROFILES AT REYNOLDS # = 0.1 MILLION/FT	20

TABLES

Table		Page
1	HYPERVELOCITY TUNNEL 9 CAPABILITIES	21
2	TUNNEL 9 SUPPLY/PITOT PRESSURE INSTRUMENTATION	21
3	TUNNEL 9 SUPPLY TEMPERATURE INSTRUMENTATION	22
4	ESTIMATE OF MEASUREMENT UNCERTAINTY	22
5	NSWCWODET TUNNEL 9 CALIBRATION DATA	23

INTRODUCTION

Calibration of wind tunnel facilities is necessary to properly evaluate and understand the data obtained during a test program. The Naval Surface Warfare Center White Oak Detachment (NSWCWODET) Hypervelocity Tunnel 9 frequently engages in facility calibrations. When Tunnel 9 was originally brought on-line, a complete characterization of the flow was completed. Periodic tests are performed to obtain additional calibration data relative to new capabilities or specific customer needs.

The National Aerospace Plane (NASP) program is a national initiative by the Department of Defense and National Aeronautics and Space Administration (NASA). The program objective is to develop hypersonic technologies for an experimental X-30 aircraft and eventually demonstrate single- stage-to-orbit flight. This program will perform multiple tests in Tunnel 9 over a wide range of test conditions. The purpose of these experiments is to evaluate various airframe, inlet, and propulsion configurations. Discrete calibration conditions were chosen which encompassed the planned testing range for the NASP program. The test data in this report includes test conditions where calibration data was previously unavailable.

This test was designed to calibrate the uniformity of the free stream flow field parameters in the Mach 10 and Mach 14 nozzles. This effort was combined with previous tunnel calibrations to create this inclusive calibration report.

TEST FACILITY

The NSWCWODET Hypervelocity Wind Tunnel 9 is a blow-down facility which operates at Mach numbers of 8, 10, and 14. Ranges for Reynolds numbers and supply conditions are listed in Table 1.

Tunnel 9 uses nitrogen as the working fluid. The test section is over 12 feet long and 5 feet in diameter, which enables testing of large scale model configurations. A schematic of Tunnel 9 is shown in Figure 1.

During a typical run, a vertical heating vessel is used to pressurize and heat a fixed volume of nitrogen to a predetermined pressure and temperature. The test section and vacuum sphere are evacuated to a low pressure and are separated from the heater by a pair of metal diaphragms. When the nitrogen in the heater reaches the desired temperature and pressure, the diaphragms are ruptured and the gas flows from the top of the heater, expands through the contoured nozzle, into the test section at the desired test conditions. As the hot gas exits the top of the heater, cooler

nitrogen (~300°F) from three pressurized driver vessels enters the heater base. The cold gas drives the hot gas in a piston-like fashion, thereby maintaining constant conditions in the test section during the run. More detailed information concerning the facility can be obtained from Reference 1.

TEST HARDWARE

Calibration hardware for this test consisted of a fixed Pitot rake mounted on a straight sting and a traversing Pitot rake as shown in Figure 2. The fixed Pitot rake consisted of 25 Pitot pressure probes, one at the centerline of the tunnel and the others placed 2 inches apart, horizontally spanning both sides of the tunnel. A traversing mechanism was fitted with three Pitot pressure probes to survey the vertical plane of the test section. One probe was mounted at the centerline, and two probes mounted 1 inch to either side. The traversing probe surveyed from 4.3 inches above the tunnel centerline to 3.0 inches from the tunnel wall.

INSTRUMENTATION

TUNNEL INSTRUMENTATION

The instrumentation used to monitor wind tunnel supply conditions included one supply pressure transducer, two supply temperature thermocouples, and two of the Pitot rake mounted pressure transducers in the test cell. Tables 2 and 3 list the transducers and valid ranges. Both sets of thermocouples were fabricated in-house.

PITOT RAKE INSTRUMENTATION

Instrumentation for both the fixed Pitot rake and the traversing Pitot rake coincide with Table 2 for Pitot pressure. Reference 2 provides more detail on Kulite transducers. All gauges were mounted inside the rake and were connected to the taps with flexible Tygon tubing. Tubing lengths were sized to minimize pressure lag as outlined in Reference 1.

CALIBRATION AND TEST PROCEDURES

PRESSURE TRANSDUCER CALIBRATION

Calibration of the pressure instrumentation was accomplished prior to each wind tunnel run. The data system recorded transducer response during evacuation of the test cell. The test cell evacuation was accomplished in steps where the test cell pressure was held constant at each step. Typically eight calibration points were

obtained from atmospheric pressure to approximately 1 mm Hg. Two MKS Baratron type 145 transducers with ranges of 1000 and 10 mm Hg were used as calibration standards. For each transducer, output voltage was recorded and a slope and intercept were calculated using a least squares method.

RUN SETUP AND INITIATION

After the pressure transducer calibration, preheat static tares were obtained on all transducers. The heating cycle, approximately 25 minutes in duration, was then started. A final tare was obtained at the end of the heating cycle for final instrumentation intercept corrections just prior to diaphragm rupture. Once flow was established, the sequencer triggered the data acquisition, traversing probe, photographic, and other tunnel control systems.

The fixed horizontal rake was held at 0 degree angle of attack. The traversing probe started at 4.3 inches above centerline and traversed into the boundary layer to approximately 3.0 inches from the wall during steady flow conditions.

DATA ACQUISITION AND REDUCTION

Data were sampled and recorded using the NSWCWODET Data Acquisition and Recording Equipment (DARE) VI. DARE VI is a simultaneous-sample-and-hold, single-amplifier-per-channel system with ±14 bit resolution. The input signals from all DARE channels were amplified and fed through six-pole, low-pass Bessel filters with a cutoff frequency of 50 Hz, thus eliminating high frequency background noise. Each channel was sampled at 251 Hz. Reference 1 gives a full description of the DARE VI system.

DIGITAL FILTERS

Data taken using the DARE VI were digitally filtered using a digital representation of a sixth order, low-pass Butterworth filter. Digital filtering allows the filter cutoff frequency to be chosen after recording and changed, if necessary, to eliminate erroneous noise. Spectral analysis may be performed to aid in choosing the cutoff frequency to prevent inadvertent distortion of the data. Time delays are avoided by filtering the data twice and reversing the data in time between the two applications of the filter. A more complete description of filtering techniques can be found in Reference 1. A cutoff frequency of 10 Hz was used for tunnel supply conditions, test cell Pitots, and all calibration rake Pitots.

MEASUREMENT UNCERTAINTY

Tunnel supply conditions and test cell Pitot pressure measurements were obtained. Free stream flow properties were then calculated using the fixed rake Pitot probes. Two Pitot probes were used to obtain free stream Pitot pressure. The Pitots were chosen to represent the Pitot position during aerodynamic model testing, based on their horizontal position in the test cell. Supply thermocouples and Pitot

transducers were averaged. From Reference 3, an estimate of the uncertainty of measured and derived flow quantities is given in Table 4.

RESULTS

Table 5 represents the data runs used in the calibration. Data were obtained at six axial stations in the test section. As shown in Figure 3, station 0 corresponds to the nozzle exit. Stations -1, 1, 2, and 3 correspond to the respective positions of -20, 24, 66, and 108 inches downstream of the nozzle exit. Run 2241 was run with an axial rake position of 72 inches downstream of the nozzle exit.

PRESENTATION OF RESULTS

Results from the Pitot rake surveys are presented for each test condition. Tabulated free stream flow field parameters are listed versus radial distance from the centerline in Appendix A. Pitot pressure at each probe on the Pitot rake was normalized by the average of two Pitots located at the edge of the inviscid core (PTAVG). Data from the Pitot pressure probes, supply pressure, and supply temperature were used to compute local free stream flow field parameters, based on an assumption of thermodynamic equilibrium in the isentropic core flow.[4] Real gas effects were accounted for by computing an equivalent perfect gas supply pressure and temperature as outlined in Reference 5. Inviscid core size was determined qualitatively for each run based on the character of the profile. One horizontal profile, averaged over the useful run time run is chosen to represent each run condition. This can be accomplished based on the tunnels temporal uniformity, symmetry in horizontal and vertical planes, and run-to-run repeatability. The next sections give examples of each characteristic.

TEMPORAL UNIFORMITY

Control valves regulate the flow of hot nitrogen through the tunnel and keep relatively constant Reynolds number conditions over the total run time. For a more complete description of Tunnel 9 operation consult Reference 1. Figure 4 shows a plot of supply conditions versus time for a standard tunnel run. The diaphragms are burst and a start-up period follows where pressure and temperature are ramped to the run values. The run values are then held constant over the usable run time. To assess the degree of temporal uniformity, normalized Pitot pressure profiles were plotted at snapshots in time during a tunnel run. Figure 5 shows five normalized Pitot pressure profiles at various times during the usable run time. As shown, the profiles vary little with time, and for all conditions, observed temporal deviations were typically on the order of 1 percent or less in pressure. Based on these observations, Pitot pressure profiles were averaged during the usable run time to obtain the spatial deviations presented in the following sections.

RADIAL SYMMETRY

To check the radial symmetry in the horizontal and vertical plane of the test section, two Pitot rakes were used. For each station and Reynolds number, the local Mach number was plotted as a function of absolute distance from the centerline. The Pitot probes were mounted at 2-inch increments radially from the centerline of the tunnel. In this manner, radial asymmetric deviations can be assessed in the horizontal flow profile. For runs where traversing Pitot data were available, the radial symmetry could be investigated between the vertical and horizontal planes. Figure 6 shows an example of how radial symmetry data was analyzed. Generally, for all run conditions asymmetric deviation was 2 percent or less in pressure, where the greater deviation of fixed Pitot or traversing Pitot reading was used. Even though the traversing probe samples each point at slightly different points in time, there was good agreement with the fixed Pitot rake. Only those Pitots that fall inside the inviscid core were used for the calculation.

RUN REPEATABILITY

For each run condition, one run is selected for a representative Pitot pressure profile. Figure 7 shows a normalized Pitot pressure plot of three separate Mach 10 runs. Notice that the profiles are very repeatable from run to run. The Mach 14 nozzle exhibits similar characteristics in run repeatability.

COMBINING CALIBRATION RESULTS WITH TEST DATA

The uniformity data presented in the preceding sections of this report represent a large amount of data. The ultimate purpose for the generation of this data is to aid in the definition of the flow profile during a test program. When a model is tested aerodynamically, the Pitot calibration rake will not be installed in the test cell. Free stream conditions are calculated as described earlier based on PO, TO, and the average of two strut-mounted Pitot probes. Refer back to Figure 2 for test cell arrangement. The calibration data can provide a definition of the flow conditions throughout the nozzle. To use the calibration data in conjunction with the aerodynamic test data, the following procedure exists. Each wind tunnel data package will contain the average supply conditions and free stream flow field parameters for the run. The average free stream flow field parameters are calculated based on measured supply conditions and the average of two strut mounted Pitot probes (PTAVG). This approach assumes constant flow field parameters across the test section. If more detailed definition of the free stream flow field is required, Appendix A lists each flow field parameter as a fraction of the PTAVG calculated quantities for each run condition and axial position. For completeness, this data should be combined with the measurement uncertainty data from Table 4.

Figures 8 through 16 are included for pretest planning purposes. The uniformity for each run condition and axial station can be compared to decide on model placement in the test section.

MACH 10 SPATIAL UNIFORMITY

Deviation of Pitot Pressure With Reynolds Number

First Window Station. For Mach 10, calibration data versus Reynolds number are available only at the first window station. Pitot pressure profiles at nominal free stream Reynolds numbers of 20×10^6, 17×10^6, 12×10^6, 5.5×10^6, and 1.0×10^6/ft are presented in Figure 8. A constant core of 40 inches was observed. The best uniformity was observed at the 20×10^6/ft condition which is closest to the nozzle design condition.[6,7]

Deviations of Pitot Pressure With Axial Position

Reynolds Number = 20×10^6/ft. Mach 10 calibration data obtained as a function of axial station are available at stations 0, 1, 2, and 3. Pitot Pressure profiles at a nominal free stream Reynolds number of 20×10^6/ft are plotted in Figure 9. The best uniformity occurred at the first window station, 24 inches downstream of the nozzle exit. The inviscid core was approximately 40 inches at all stations except the third window station. At this station the inviscid core was 32 inches. Test models are generally tested in the first two window stations at these conditions.

MACH 14 SPATIAL UNIFORMITY

Deviations of Pitot Pressure With Reynolds Number

First Window Station. At the first window station, 24 inches downstream from the nozzle exit, data were obtained at nominal free stream Reynolds numbers of 4.0×10^6, 2.0×10^6, 0.5×10^6, and 0.1×10^6/ft. Figure 10 shows local normalized Pitot pressure plotted versus radial distance from the centerline as a function of Reynolds number. As the Reynolds number increased toward the nozzle design condition, the profiles become more uniform across the test section with a lower pressure at the center 9 inches of the test section. A constant core of approximately 36 inches in diameter was observed except for the lowest Reynolds number condition where the core was 28 inches in diameter.

Second Window Station. At the second window station, 66 inches downstream from the nozzle exit, data were obtained at nominal free stream Reynolds numbers of 4.0×10^6, 2.0×10^6, and 0.5×10^6/ft. Figure 11 shows local normalized Pitot pressure plotted versus radial distance from centerline as a function of Reynolds number. A constant 36-inch diameter inviscid core was observed, except for the lowest Reynolds number condition where the core was 32 inches in diameter.

Third Window Station. At the third window station, 108 inches downstream from the nozzle exit, data were obtained at nominal free stream Reynolds numbers of 4.0×10^6, 2.0×10^6, and 0.5×10^6/ft. Figure 12 shows local Mach number plotted versus radial distance from the centerline as a function of Reynolds number. A constant 36-inch diameter inviscid core was observed, except for the lowest Reynolds number condition where the core was 28 inches in diameter, and the pressure drops as the centerline is approached.

Deviations of Pitot Pressure With Axial Position

Reynolds Number = 4.0×10^6/ft. Data at the maximum Reynolds number condition were obtained axially at six locations in the test section from 20 inches upstream of the nozzle exit to 108 inches downstream of the nozzle exit. Figure 13 is a plot of local normalized Pitot pressure versus radial distance from centerline at each of the six axial stations. A constant inviscid core was 36 inches in diameter. Pitot pressure was a minimum at the center of the test section for axial distances up to 48 inches. Pressure deviations at the second and third window stations were typically smaller without a dip in pressure at the center.

Reynolds Number = 2.0×10^6/ft. Data at a nominal Reynolds number of 2.0×10^6/ft were obtained axially at three locations in the test section at 24, 66, and 108 inches downstream of the nozzle exit. Figure 14 shows a plot of local normalized Pitot pressure versus radial distance from centerline at each of the three axial stations. A constant inviscid core of 36 inches in diameter was observed. Deviations were centered about a median value, except for the first window station where the local Pitot pressure decreased as the centerline was approached.

Reynolds Number = 0.5×10^6/ft. Data at 0.5×10^6/ft were obtained axially at three locations in the test section at 24, 66, and 108 inches downstream of the nozzle exit. Figure 15 shows a plot of local normalized Pitot pressure versus radial distance from centerline at each of the three axial stations. A constant 36-inch diameter inviscid core was observed, except for the third window position where the core was 28 inches in diameter, and the pressure drops as the centerline is approached. Deviations were centered about a median value, except for the third window station where pressure decreased as the centerline was approached.

Reynolds Number = 0.1×10^6/ft. Data at 0.1×10^6/ft were obtained at only one station 24 inches downstream of the nozzle exit. Figure 16 shows a plot of local normalized Pitot pressure versus radial distance from the centerline. The inviscid core was 28 inches in diameter. Pitot pressure generally decreased as the centerline was approached.

SUMMARY

Calibration data obtained in NSWCWODET Hypervelocity Tunnel 9 verify that high quality uniform flow exists at Mach 10 and 14. Spatial and temporal uniformity as well as symmetry were investigated. Flow uniformity was found to be the best in the second and third window stations, with uniformity in Mach number nominally less than ± 0.75 percent. In general, higher Reynolds number free stream conditions tend to exhibit better uniformity. Calibration data from the Mach 8 and Mach 18 nozzle will be subsequently added to this report when that data becomes available.

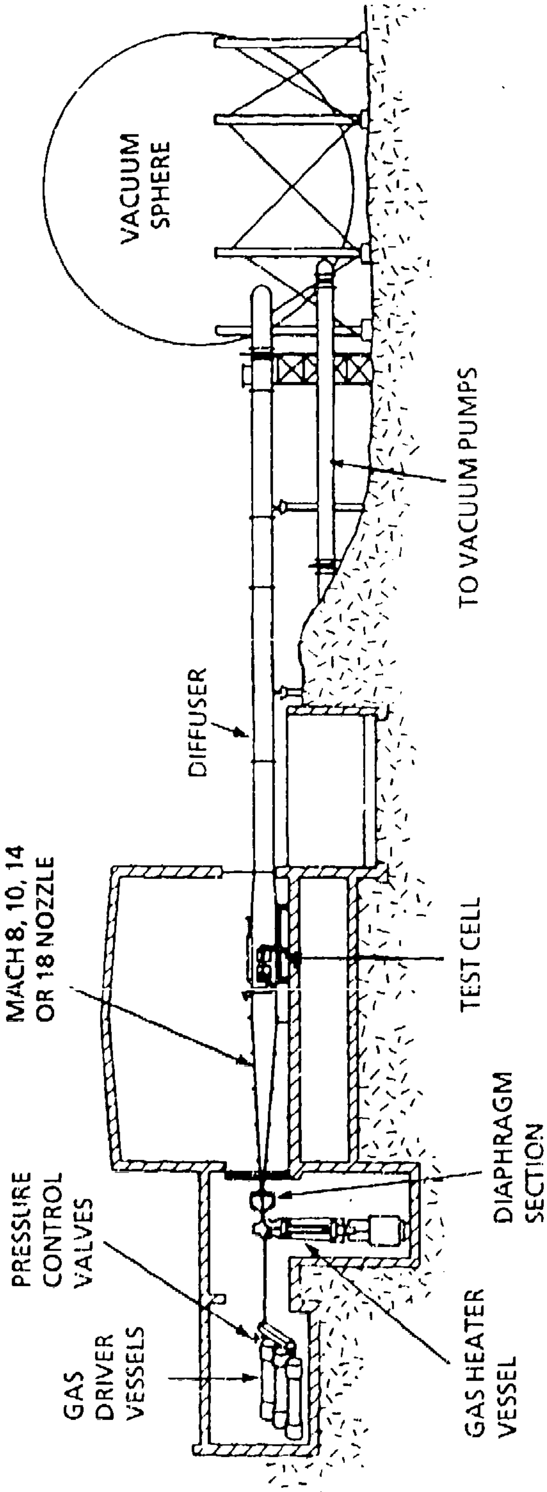


FIGURE 1. NSWCWODET HYPERVELOCITY TUNNEL 9

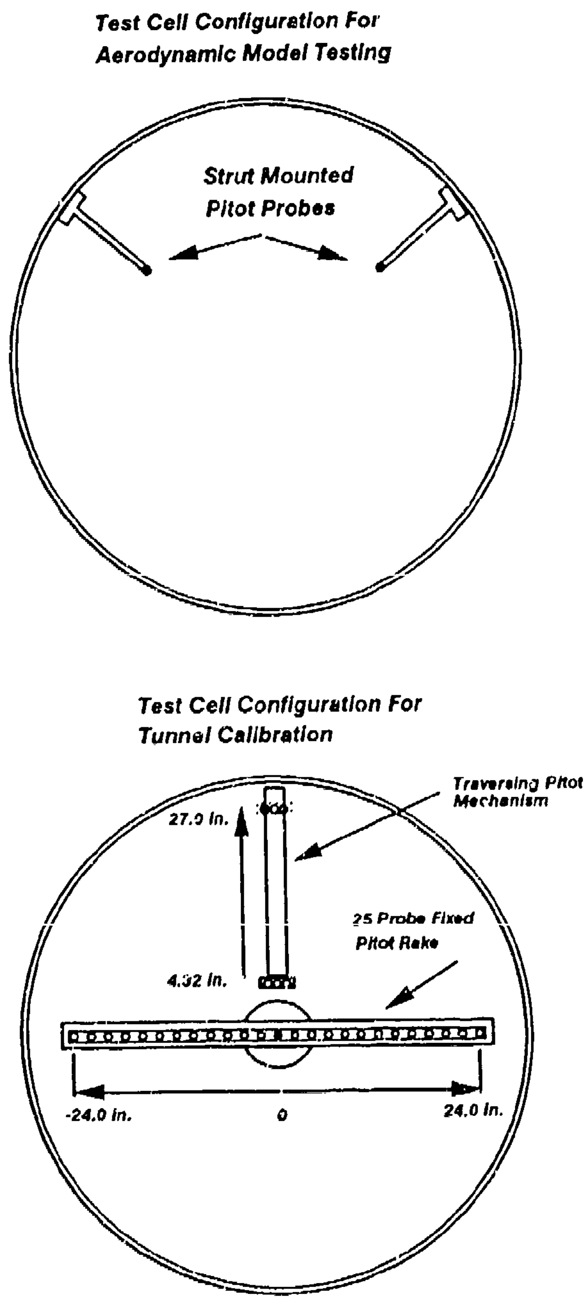


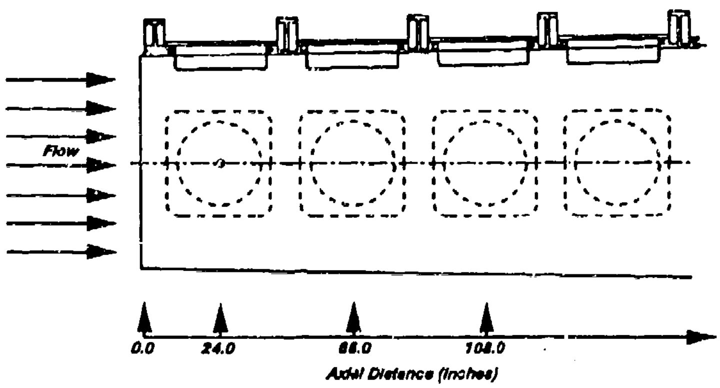
FIGURE 2. TUNNEL 9 CALIBRATION SETUP

Mach 10

Exit	1ST Window	2ND Window	3RD Window	
●	●	●	●	Re# = 20 Million/ft.
○	●	○	○	Re# = 17 Million/ft.
○	●	○	○	Re# = 12 Million/ft.
○	●	○	○	Re# = 5 Million/ft.
○	●	○	○	Re# = 1 Million/ft.

Mach 14

Exit	1ST Window	2ND Window	3RD Window	
○	●	●	●	Re# = 3.8 Million/ft.
○	●	●	●	Re# = 2.0 Million/ft.
○	●	●	●	Re# = 0.8 Million/ft.
○	●	○	○	Re# = 0.1 Million/ft.



Key
- ● Station Included in Calibration Data
- ○ Station not Included in Calibration Data

FIGURE 3. TUNNEL 9 CALIBRATION STATIONS

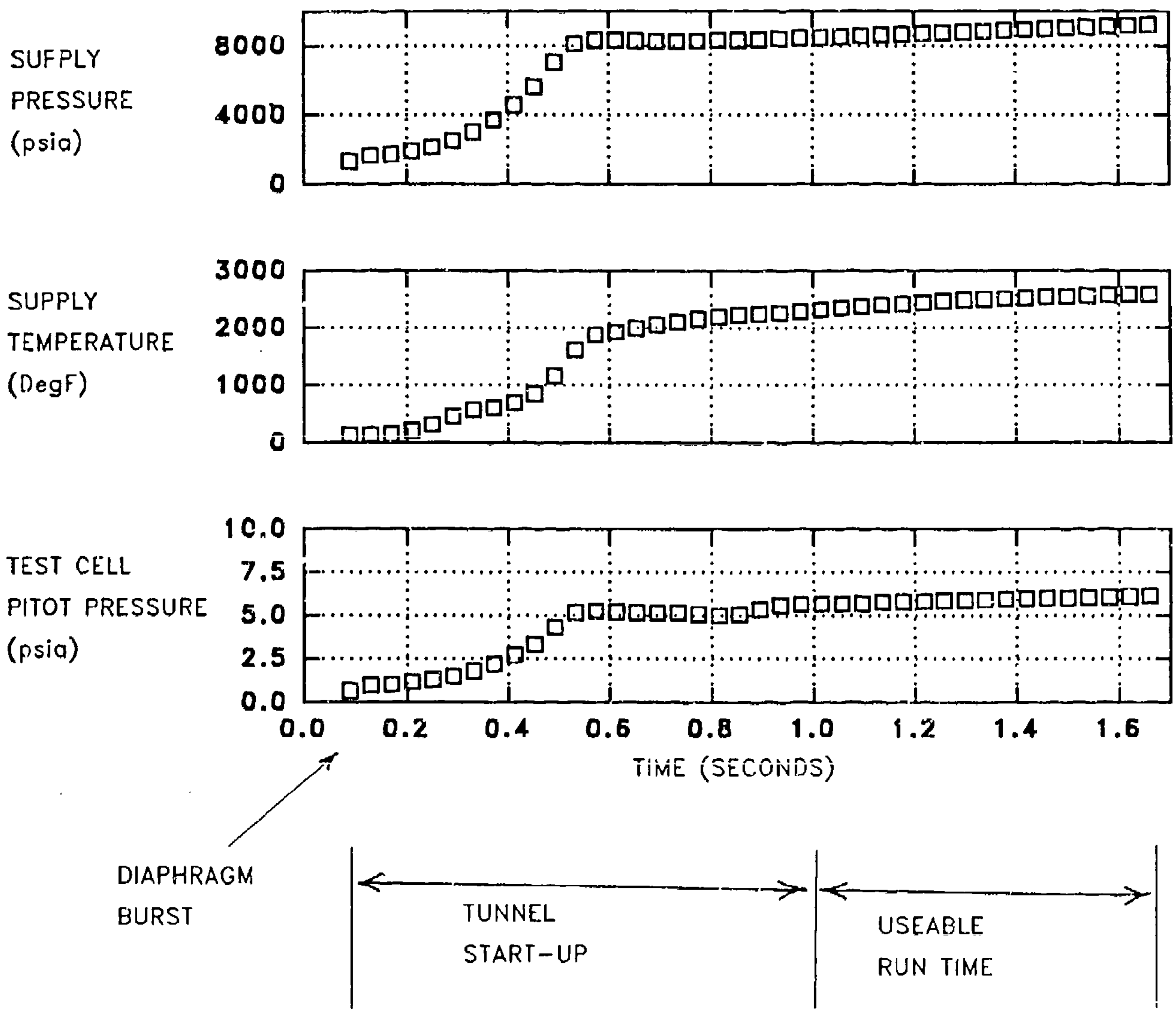


FIGURE 4. TUNNEL 9 SUPPLY CONDITIONS

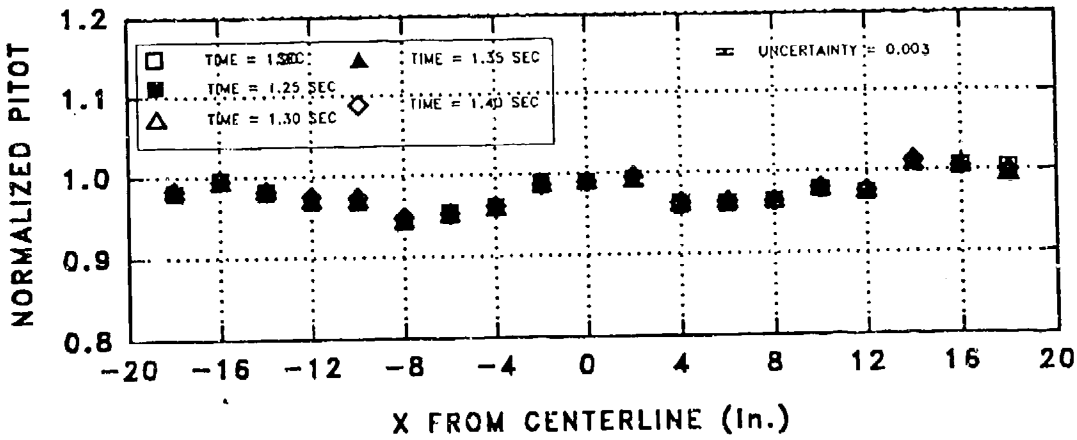


FIGURE 5. TUNNEL 9 TEMPORAL UNIFORMITY

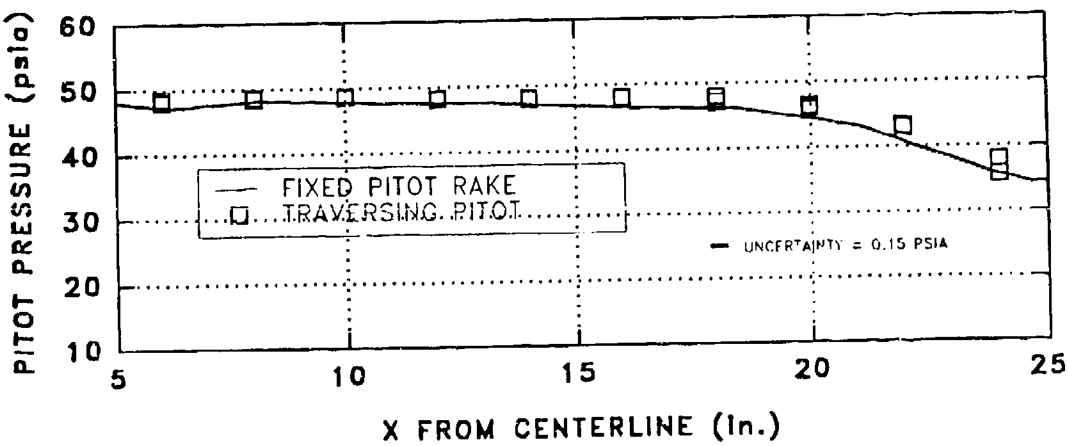


FIGURE 6. COMPARISON OF HORIZONTAL AND VERTICAL PROFILES

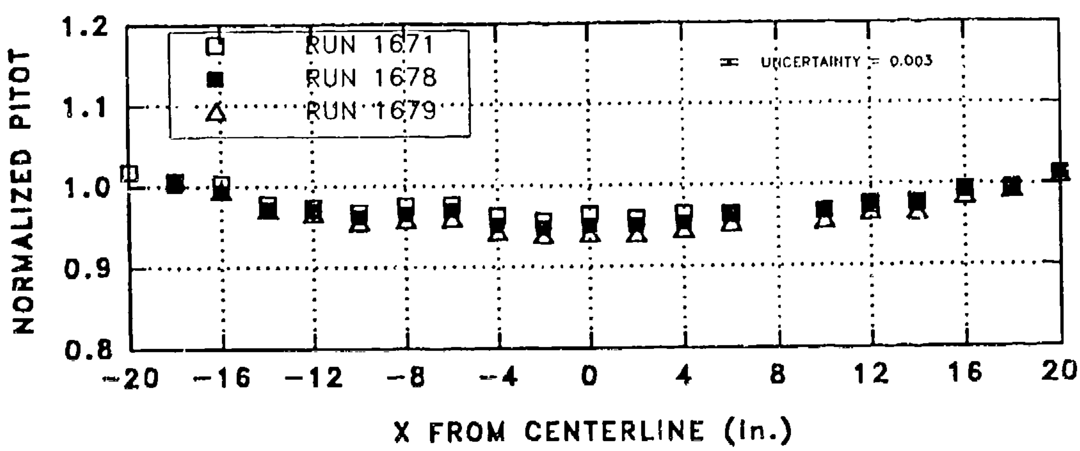


FIGURE 7. COMPARISON OF RUN REPEATABILITY

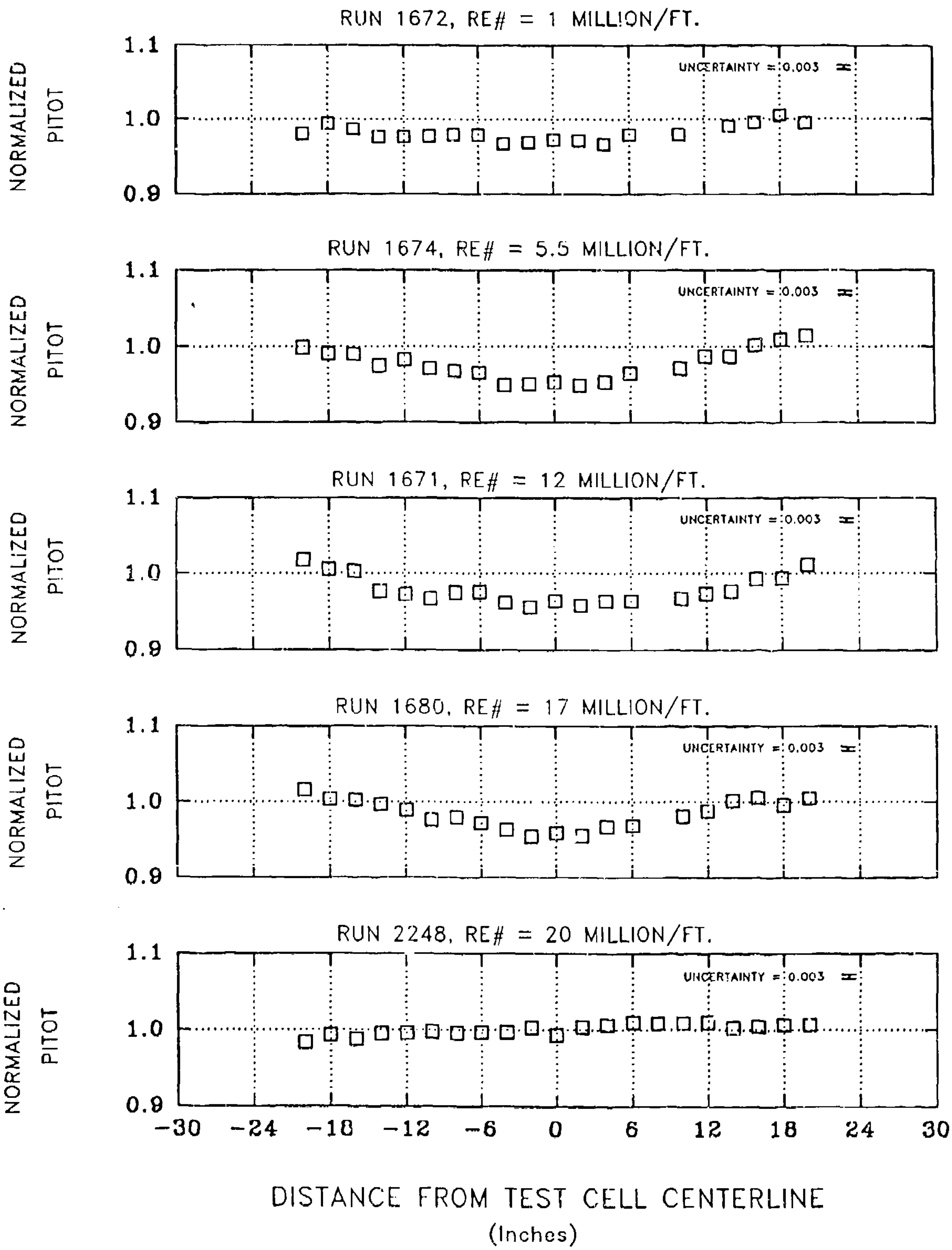


FIGURE 8. MACH 10 NORMALIZED PITOT PROFILES AT FIRST WINDOW STATION

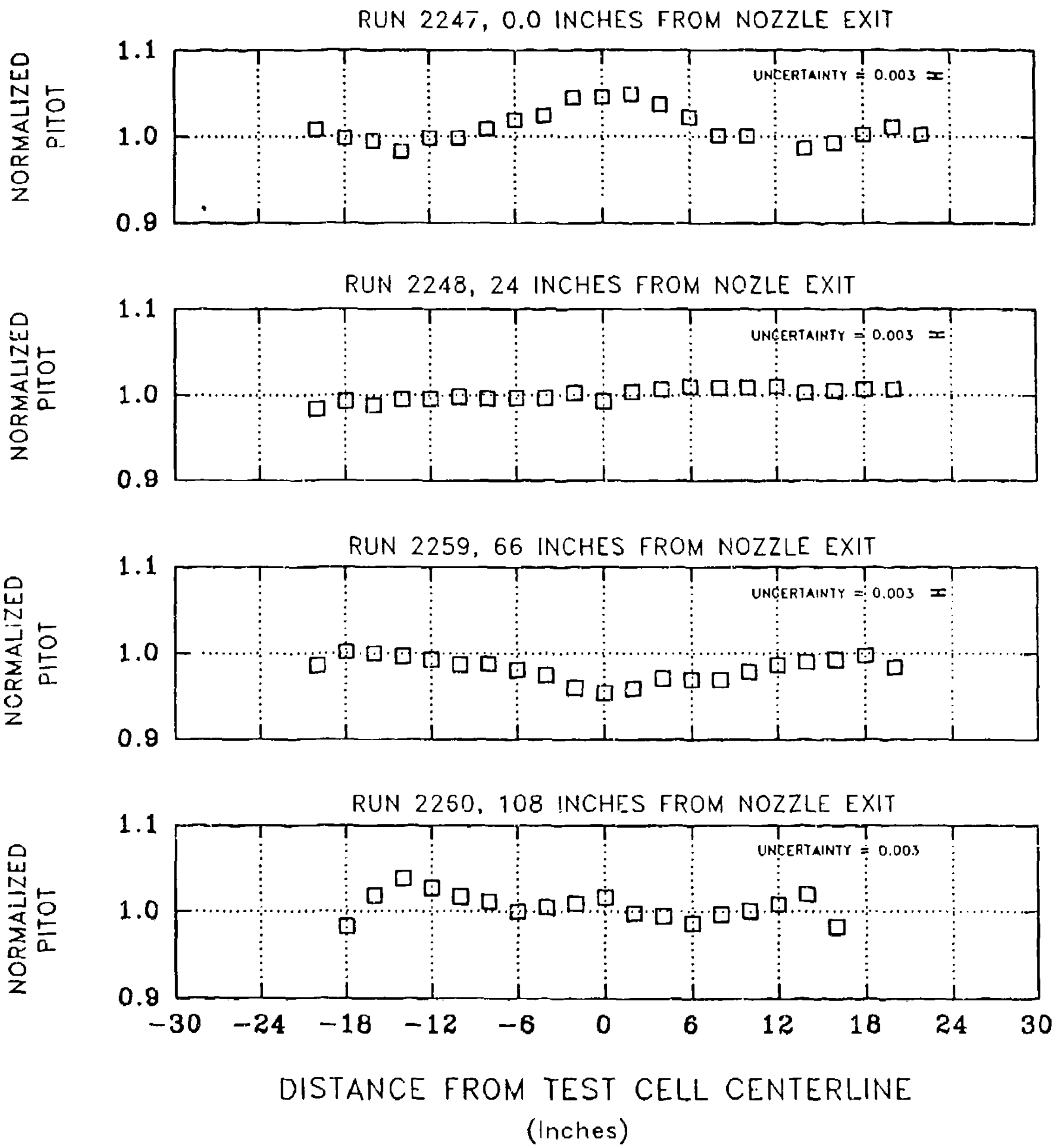


FIGURE 9. MACH 10 NORMALIZED PITOT PROFILES AT REYNOLDS # = 20 MILLION/FT

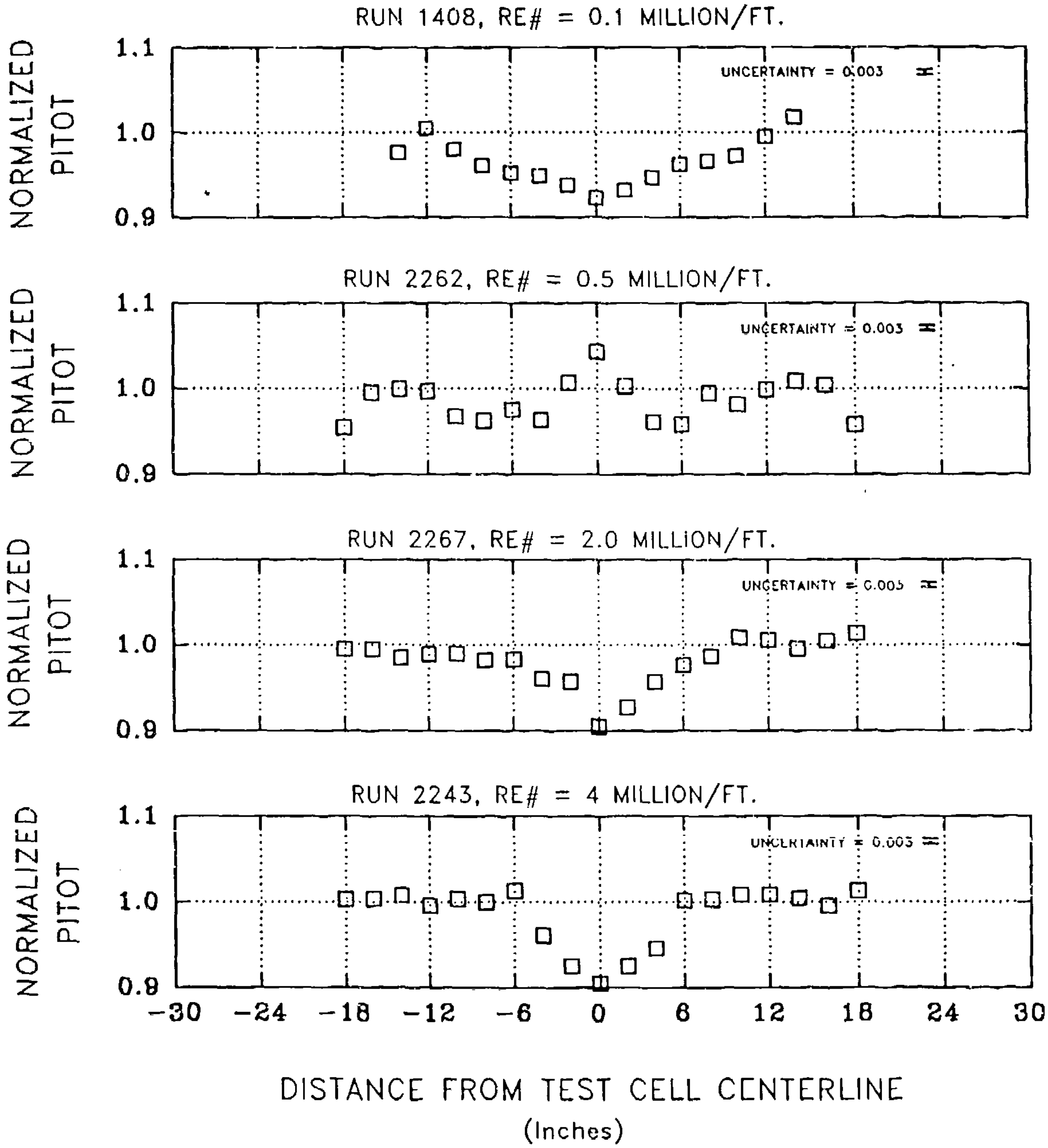


FIGURE 10. MACH 14 NORMALIZED PITOT PROFILES AT FIRST WINDOW STATION

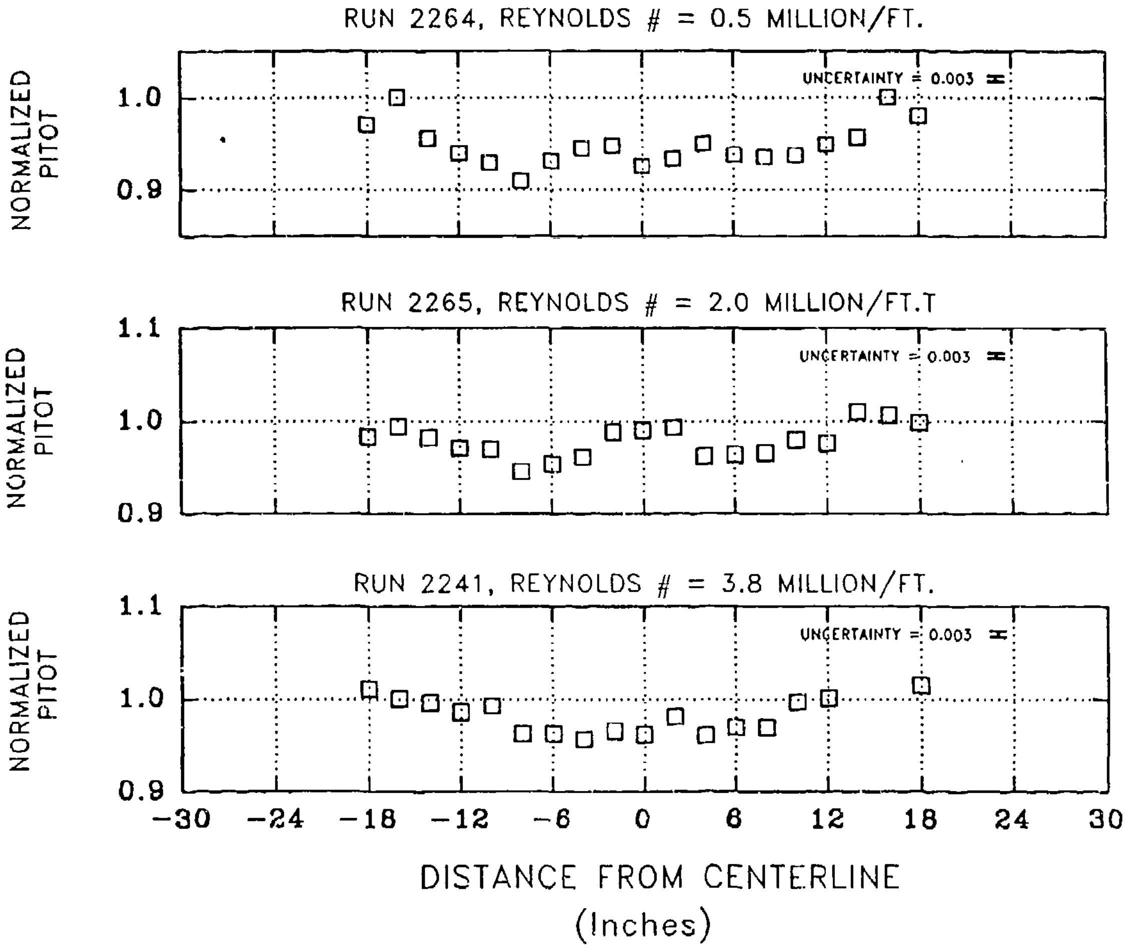


FIGURE 11. MACH 14 NORMALIZED PITOT PROFILES AT SECOND WINDOW STATION

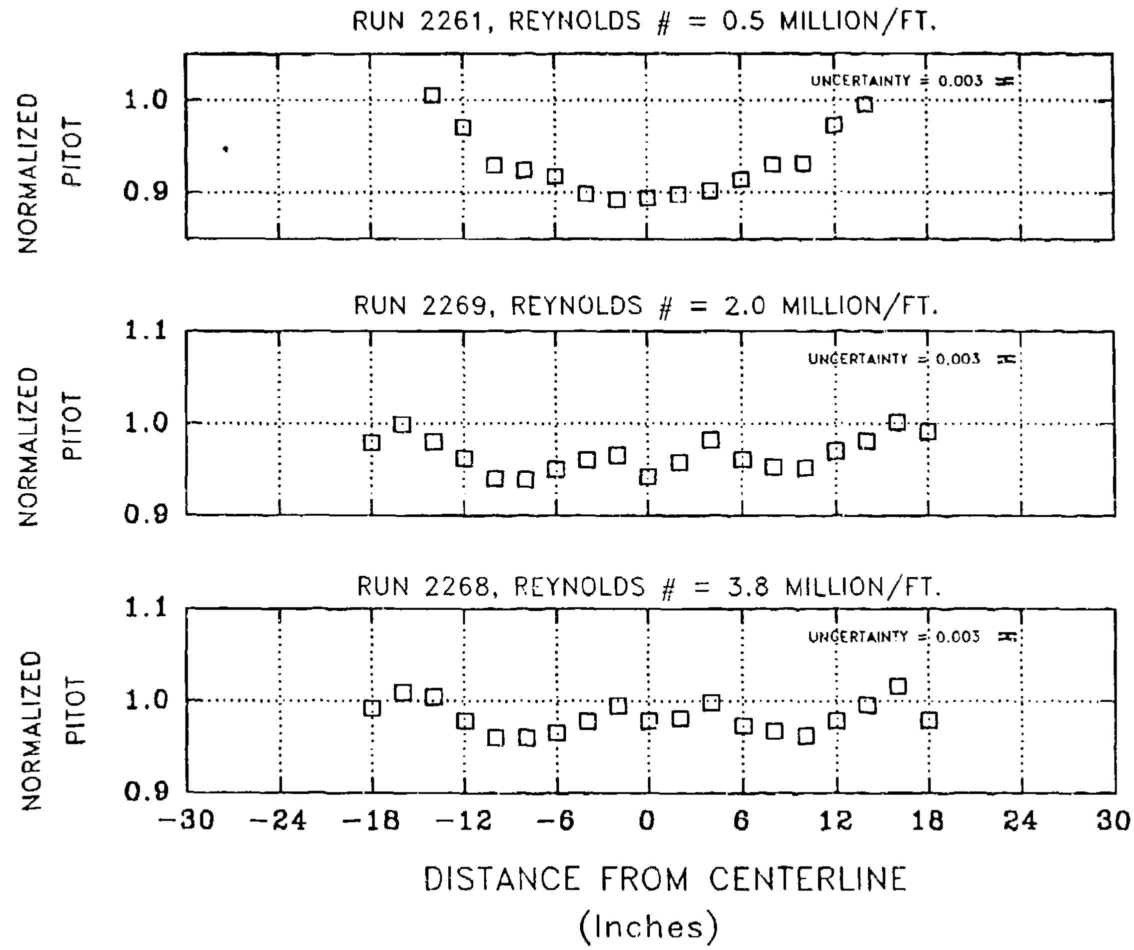


FIGURE 12. MACH 14 NORMALIZED PITOT PROFILES AT THIRD WINDOW STATION

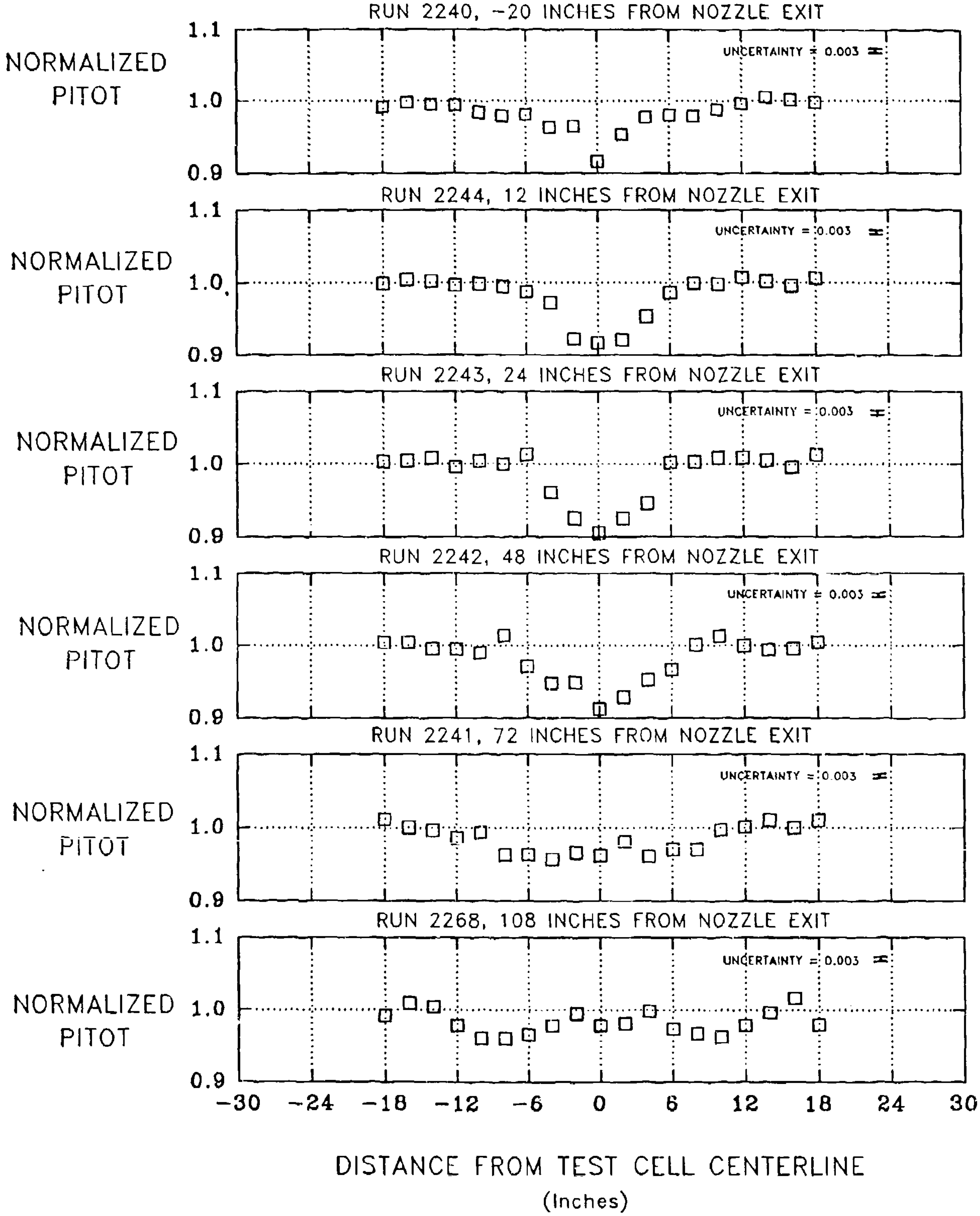


FIGURE 13. MACH 14 NORMALIZED PITOT PROFILES AT REYNOLDS # = 4 MILLION/FT

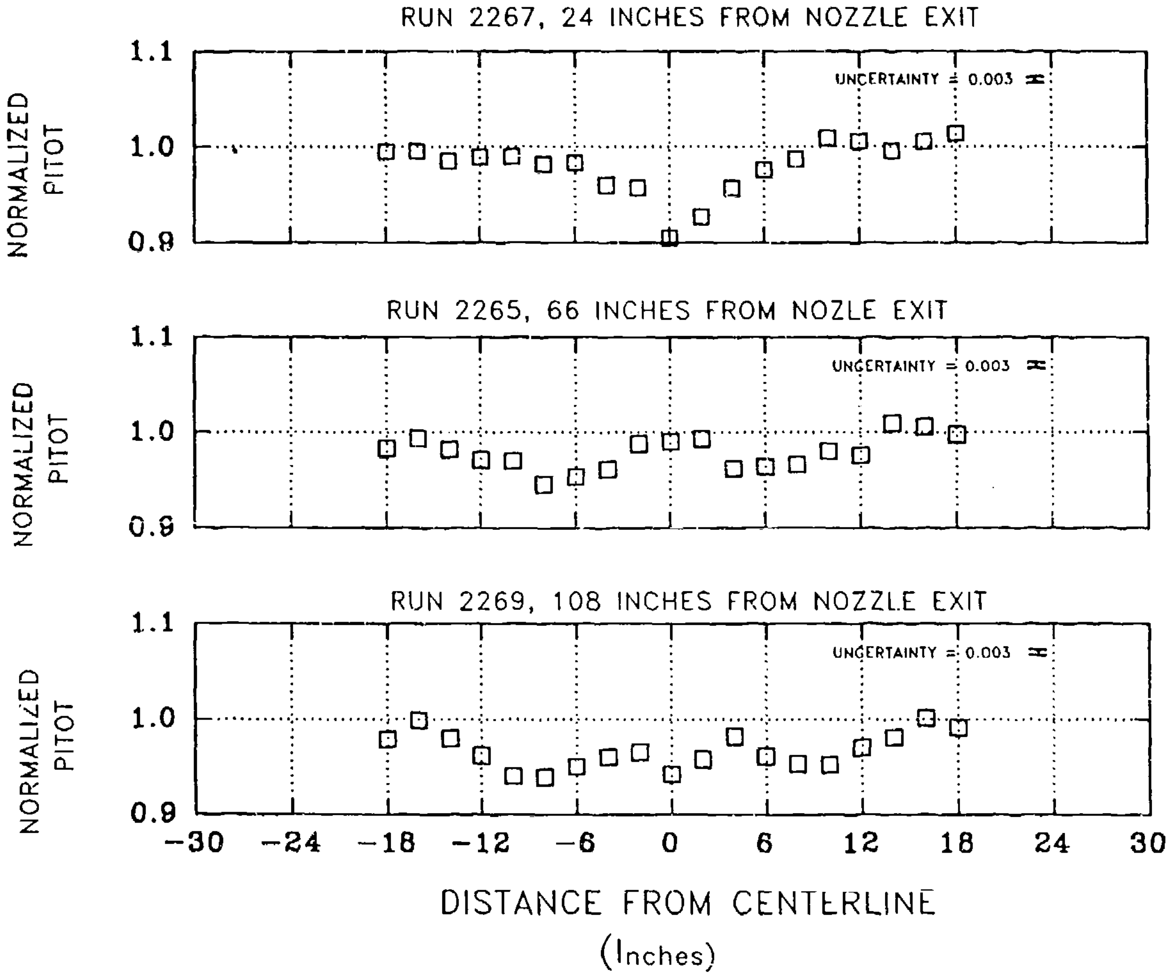


FIGURE 14. MACH 14 NORMALIZED PITOT PROFILES AT REYNOLDS # = 2 MILLION/FT

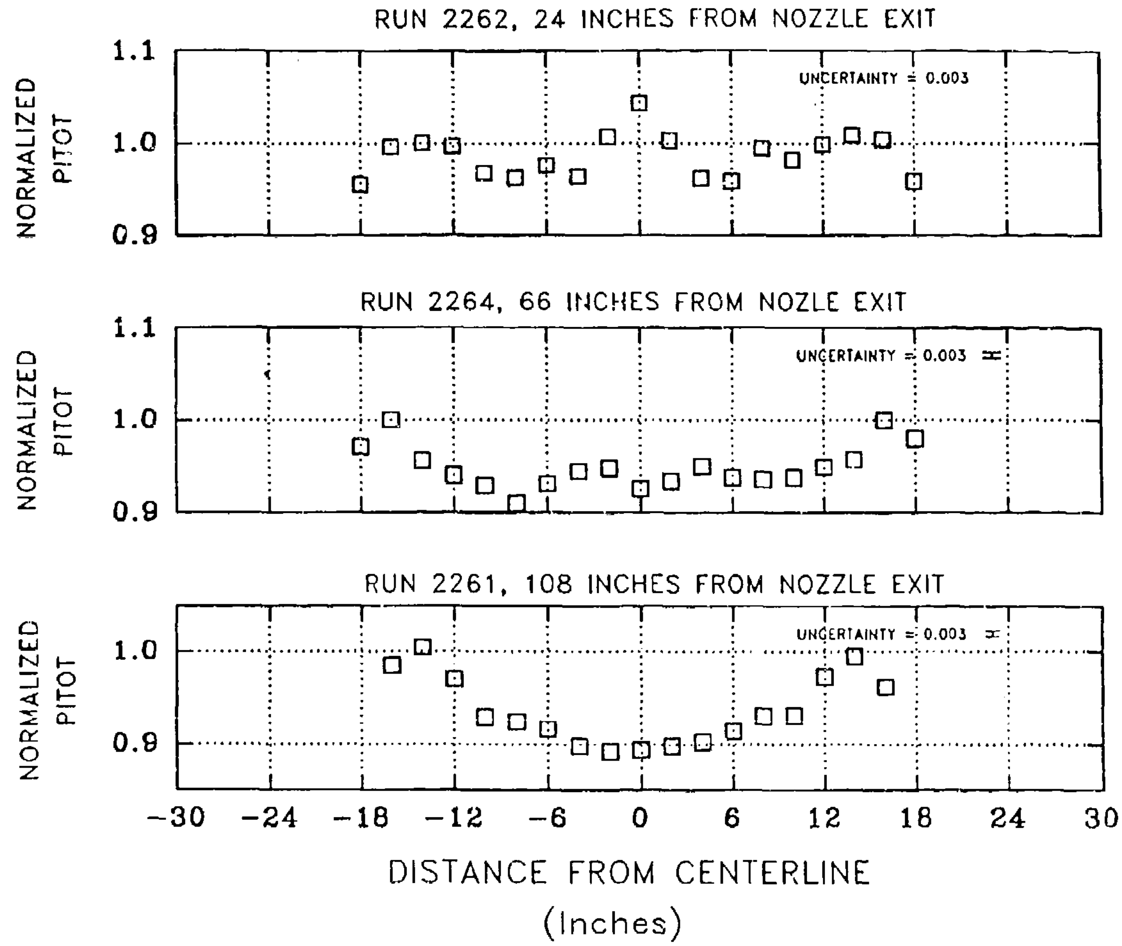


FIGURE 15. MACH 14 NORMALIZED PITOT PROFILES AT REYNOLDS # = 0.5 MILLION/FT

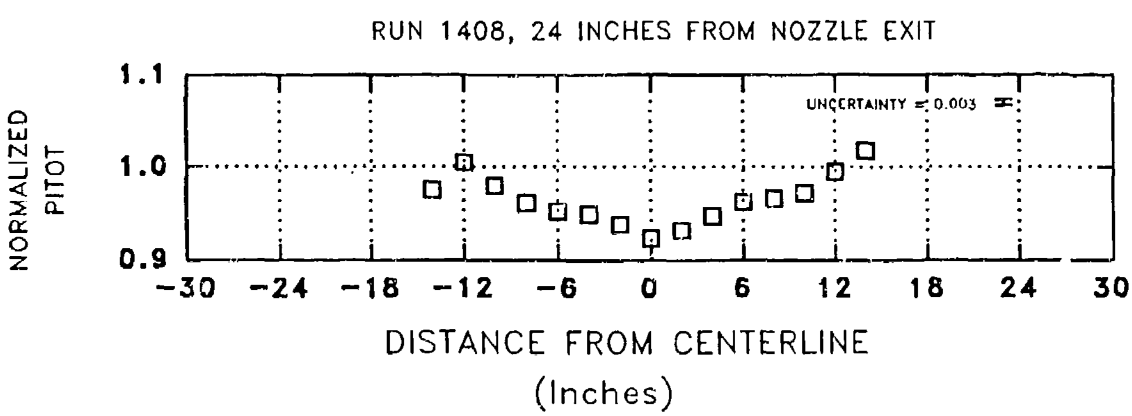


FIGURE 16. MACH 14 NORMALIZED PITOT PROFILES AT REYNOLDS # = 0.1 MILLION/FT

TABLE 1. HYPERVELOCITY TUNNEL 9 CAPABILITIES

Contoured Nozzle	Supply Pressure Range (psia)	Nominal Supply Temperature (°F)	Reynolds Number Range ($X10^6$/ft)	Run Time Range (s)
8	4,000 to 12,000	1,100	17.6 to 50.0	0.33 to 1.3
10	500 to 14,000	1,350	0.86 to 20.0	0.23 to 8
14	100 to 20,000	2,750	0.072 to 3.8	0.7 to 15

TABLE 2. TUNNEL 9 SUPPLY/PITOT PRESSURE INSTRUMENTATION

Free Stream Nominal Reynolds Number	Supply Pressure Transducer (Range)	Pitot Pressure Transducer (Range)
Mach 10		
Re# = 1 million/ft	Viatran model 304 (0 to 10,000 psia)	Kulite model XCW-093-15A (0 to 15 psia)
Re# = 7 million/ft	Viatran model 304 (0 to 10,000 psia)	Statham model PA288TC (0 to 50 psia)
Re# = 12 million/ft	Viatran model 214 (0 to 20,000 psia)	Statham model PA288TC (0 to 50 psia)
Re# = 20 million/ft	Viatran model 214 (0 to 20,000 psia)	Statham model PA288TC (0 to 50 psia)
Mach 14		
Re# = 0.1 million/ft	Statham model PA24TC (0 to 1,000 psia)	Kulite model XCW-062-5A (0 to 5 psia)
Re# = 0.5 million/ft	Viatran model 214 (0 to 50,000 psia)	Kulite model XCW-093-15A (0 to 15 psia)
Re# = 2 million/ft	Viatran model 214 (0 to 50,000 psia)	Kulite model XCW-093-15A (0 to 15 psia)
Re# = 3.8 million/ft	Viatran model 214 (0 to 50,000 psia)	Kulite model XCW-093-15A (0 to 15 psia)

TABLE 3. TUNNEL 9 SUPPLY TEMPERATURE INSTRUMENTATION

Freestream Nominal Mach Number	Supply Temperature Transducer (Range)
Mach 10	chromel /alumel (0 to 2200°F)
Mach 14	tungsten-5% rhenium/tungsten-26% (0 to 4200°F)

TABLE 4. ESTIMATE OF MEASUREMENT UNCERTAINTY

Measured Quantity	Uncertainty
P0	± 0.4%
T0	-1.7 to +0.5%
Pitot	± 0.3%
Derived Quantity	
Minf	-0.2 to +0.14%
Tinf	-1.9 to +0.6%
Pinf	-0.6 to +0.5%
Qinf	± 0.3%
RHOinf	-1.6 to +0.55%
Uinf	-0.8 to +0.2%
Reinf/L	-2.6 to +0.8%

TABLE 5. NSWCWODET TUNNEL 9 CALIBRATION DATA

RUN #	MACH #	RE#/FT x 10^6	AXIAL STATION (inches)	SUPPLY PRESSURE (psia)	SUPPLY TEMP (°F)	PTAVG (psia)	PTmean/ PTAVG	DEVIATION IN PRESSURE ± %	CORE DIAMETER (inches)
FIRST WINDOW STATION									
1672	9.64	1.07	24	580	1140	2.07	0.979	+1% to -5.8%	40
1674	9.91	5.55	24	3600	1290	12.04	0.977	+1% to -5.2%	40
1671	10.10	11.7	24	8000	1350	26.85	0.979	+2% to -4.4%	40
1680	10.46	16.8	24	11600	1320	36.16	0.984	+2% to -4.6%	40
2248	10.45	22.7	24	14000	1255	47.14	1.00	+1% to -1.6%	40
1408	12.45	0.07	24	225	2290	0.21	0.965	+2% to -7.7%	28
2262	13.21	0.55	24	2100	2400	1.53	0.986	+4% to -4.5%	36
2267	13.70	2.03	24	8750	2500	5.79	0.980	+1% to -9.5%	36
2240	14.19	4.10	-20	20100	2660	12.66	0.981	+1% to -8.4%	36
2243	14.45	4.81	24	20200	2375	12.38	0.984	+1% to 9.5%	36
SECOND WINDOW STATION									
2259	10.37	22.0	66	14250	1320	49.10	0.982	0 to -4.6%	40
2264	13.10	0.54	66	2250	2550	1.67	0.949	0 to -9.0%	36
2265	13.70	1.88	66	9250	2700	5.96	0.979	+1% to -5.4%	36
2241	14.16	3.43	72	19500	2880	11.79	0.982	+2% to -4.3%	36
THIRD WINDOW STATION									
2260	10.43	21.8	108	14100	1300	47.33	0.991	+3.8% to -9.3%	32
2261	13.17	0.52	108	2100	2475	1.53	0.935	+1% to 10.8%	28
2269	13.68	2.01	108	9500	2650	6.24	0.967	+0 to 6.1%	36
2268	14.35	3.84	108	20000	2700	11.82	0.983	+2% to -4.3%	36

REFERENCES

1. Boyd, C., *Hypervelocity Wind Tunnel 9 Handbook*, Third Edition, NAVSWC TR 91-616, Jul 1993, NAVSWC, Silver Spring, MD.

2. Kulite Semiconductor Products Inc., *Kulite Miniature IS Silicon Diaphragm Pressure Transducer Catalog*, Bulletin KS-10000, Ridgefield, NJ.

3. NAVSWC K24-MEK Memorandum, Subj: Update on Uncertainties in Derived Tunnel Conditions, White Oak, MD, Mar 92.

4. Brahinsky, H.S., and Neel, C.A., *Tables of Equilibrium Thermodynamic Properties of Nitrogen, Volume III. Constant Entropy*, AEDC TR-69-126, Final Report, Jan 66-Jan 69, AEDC, Arnold AF Station, TN.

5. Culotta, S., and Richards, B.E., *Methods for Determining Conditions in Real Nitrogen Expanding Flows*, VKI TN 58, Feb 1970, VKI, Rhode St. Genese, Belgium.

6. Glowacki, W.J., *NOL Hypervelocity Wind Tunnel, Report No. 2: Nozzle Design*, NOLTR 71-6, Apr 1971.

7. Harris, E.L., Glowacki, W.J., *NOL Hypervelocity Wind Tunnel, Report No. 1: Aerodynamic Design*, NOLTR 71-5, Feb 1971.

GLOSSARY

a	Velocity of the local speed of sound, ft/s
CL	Centerline of wind tunnel
CP	Pressure coefficient (P - Pinf)/Qinf
Mach	Free stream Mach number, Mach = Uinf/a
Pinf	Free stream static pressure, psia
PO, Po	Tunnel supply pressure, psia
PO1	Equivalent perfect gas supply pressure, psia
PTAVG	Average of strut mounted Pitot pressure probes, psia
PT5	Rake pressure transducer, -16 in. from CL, psia
PT21	Rake pressure transducer, 16 in. from CL, psia
PTN	Tunnel Pitot pressure, north side, psia
PTRAV	Traverse Pitot pressure transducer , psia
PTS	Tunnel Pitot pressure, south side, psia
Qinf	Free stream dynamic pressure, psia
Reinf/L	Free stream Reynolds number, ft^{-1}
Tinf	Free stream static temperature, °F
TO	Tunnel supply temperature, °F
TO1	Equivalent perfect gas supply temperature, °F
Uinf	Free stream velocity, ft/s

APPENDIX A

FREE STREAM FLOW FIELD PARAMETERS FOR ALL NOMINAL TEST CONDITIONS

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1436, RUN 1408, STATION 12 inches

MACH = 12.45 PO = 225. psia TO = 2290. degF PTAVG = 0.21 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
12.45	0.115	92.7	1.06E-03	7.39E+04	5979.	2.99E-05	4.58E-02

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.228	1.357	0.229	0.551	0.124	0.407	1.007	0.225	2.128
2	-22.00	0.331	1.258	0.331	0.640	0.209	0.510	1.006	0.327	1.762
3	-20.00	0.462	1.174	0.463	0.732	0.336	0.625	1.004	0.459	1.485
4	-18.00	0.633	1.100	0.633	0.831	0.523	0.757	1.003	0.630	1.265
5	-16.00	0.830	1.040	0.830	0.927	0.768	0.893	1.001	0.828	1.100
6	-14.00	0.976	1.005	0.976	0.990	0.966	0.985	1.000	0.976	1.013
7	-12.00	1.005	0.999	1.005	1.002	1.007	1.003	1.000	1.005	0.997
8	-10.00	0.980	1.004	0.980	0.992	0.972	0.988	1.000	0.980	1.011
9	-8.00	0.961	1.008	0.962	0.984	0.946	0.976	1.000	0.961	1.020
10	-6.00	0.952	1.010	0.952	0.980	0.933	0.971	1.000	0.952	1.026
11	-4.00	0.949	1.011	0.949	0.979	0.928	0.968	1.000	0.948	1.027
12	-2.00	0.938	1.013	0.939	0.975	0.914	0.962	1.000	0.938	1.033
13	0.00	0.923	1.017	0.923	0.968	0.893	0.952	1.001	0.922	1.042
14	2.00	0.932	1.015	0.932	0.972	0.906	0.958	1.000	0.932	1.037
15	4.00	0.947	1.011	0.947	0.978	0.926	0.968	1.000	0.947	1.028
16	6.00	0.962	1.008	0.962	0.984	0.947	0.977	1.000	0.962	1.020
17	8.00	0.966	1.007	0.966	0.986	0.952	0.979	1.000	0.966	1.018
18	10.00	0.972	1.006	0.972	0.988	0.960	0.983	1.000	0.971	1.015
19	12.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.003
20	14.00	1.018	0.996	1.018	1.007	1.026	1.011	1.000	1.019	0.991
21	16.00	0.938	1.013	0.938	0.974	0.913	0.962	1.000	0.937	1.033
22	18.00	0.771	1.056	0.771	0.900	0.692	0.854	1.002	0.769	1.143
23	20.00	0.598	1.113	0.598	0.812	0.483	0.731	1.003	0.595	1.302
24	22.00	0.428	1.193	0.428	0.710	0.301	0.596	1.005	0.424	1.545
25	24.00	0.207	1.384	0.207	0.530	0.108	0.383	1.008	0.204	2.235

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1436, RUN 1409, STATION 24 inches

MACH = 12.62 PO = 95. psia TO = 1340. degF PTAVG = 0.09 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
12.62	0.050	56.7	4.48E-04	6.54E+04	4739.	2.06E-05	4.94E-02

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.245	1.338	0.245	0.567	0.137	0.424	1.007	0.242	2.053
2	-22.00	0.394	1.213	0.394	0.687	0.268	0.567	1.005	0.391	1.610
3	-20.00	0.530	1.141	0.531	0.774	0.408	0.680	1.004	0.527	1.384
4	-18.00	0.684	1.082	0.685	0.858	0.585	0.794	1.002	0.682	1.215
5	-16.00	0.854	1.034	0.854	0.938	0.799	0.908	1.001	0.852	1.085
6	-14.00	0.953	1.010	0.953	0.981	0.934	0.971	1.000	0.952	1.025
7	-12.00	0.994	1.001	0.994	0.998	0.992	0.997	1.000	0.994	1.003
8	-10.00	0.993	1.002	0.993	0.997	0.990	0.996	1.000	0.993	1.004
9	-8.00	0.961	1.008	0.961	0.984	0.946	0.976	1.000	0.961	1.020
10	-6.00	0.902	1.022	0.902	0.959	0.864	0.939	1.001	0.901	1.054
11	-4.00	0.846	1.035	0.846	0.935	0.789	0.903	1.001	0.845	1.090
12	-2.00	0.824	1.041	0.824	0.925	0.760	0.889	1.001	0.822	1.105
13	0.00	0.823	1.041	0.824	0.924	0.760	0.888	1.001	0.822	1.105
14	2.00	0.837	1.038	0.837	0.930	0.777	0.897	1.001	0.835	1.096
15	4.00	0.842	1.036	0.842	0.933	0.784	0.901	1.001	0.840	1.092
16	6.00	0.876	1.028	0.876	0.948	0.829	0.923	1.001	0.875	1.070
17	8.00	0.934	1.014	0.934	0.973	0.908	0.959	1.000	0.933	1.036
18	10.00	0.986	1.003	0.986	0.994	0.980	0.991	1.000	0.985	1.007
19	12.00	1.006	0.999	1.006	1.002	1.008	1.003	1.000	1.006	0.997
20	14.00	1.001	1.000	1.001	1.000	1.001	1.000	1.000	1.001	1.000
21	16.00	0.956	1.009	0.956	0.982	0.939	0.973	1.000	0.956	1.023
22	18.00	0.825	1.041	0.825	0.925	0.761	0.889	1.001	0.823	1.104
23	20.00	0.665	1.089	0.665	0.848	0.561	0.780	1.002	0.662	1.233
24	22.00	0.485	1.162	0.485	0.746	0.359	0.643	1.004	0.481	1.449
25	24.00	0.059	1.784	0.060	0.321	0.019	0.179	1.011	0.058	4.212

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1436, RUN 1411, STATION 24 inches

MACH = 12.96 PO = 290. psia TO = 2000. degF PTAVG = 0.23 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
12.96	0.127	75.9	1.08E-03	1.05E+05	5630.	3.71E-05	4.00E-02

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.317	1.268	0.318	0.629	0.198	0.497	1.006	0.314	1.798
2	-22.00	0.451	1.179	0.451	0.725	0.324	0.616	1.004	0.448	1.503
3	-20.00	0.631	1.100	0.631	0.830	0.521	0.755	1.003	0.628	1.266
4	-18.00	0.828	1.040	0.828	0.927	0.766	0.892	1.001	0.827	1.101
5	-16.00	0.987	1.003	0.987	0.995	0.981	0.992	1.000	0.987	1.007
6	-14.00	1.039	0.992	1.039	1.016	1.055	1.023	1.000	1.039	0.981
7	-12.00	1.006	0.999	1.006	1.002	1.008	1.004	1.000	1.006	0.997
8	-10.00	0.968	1.007	0.968	0.987	0.956	0.981	1.000	0.968	1.017
9	-8.00	0.956	1.009	0.956	0.982	0.939	0.973	1.000	0.956	1.023
10	-6.00	0.951	1.011	0.951	0.980	0.931	0.970	1.000	0.950	1.026
11	-4.00	0.957	1.009	0.957	0.982	0.940	0.974	1.000	0.956	1.023
12	-2.00	0.950	1.011	0.951	0.980	0.931	0.970	1.000	0.950	1.026
13	0.00	0.943	1.012	0.943	0.977	0.921	0.965	1.000	0.943	1.030
14	2.00	0.949	1.011	0.949	0.979	0.928	0.968	1.000	0.948	1.027
15	4.00	0.960	1.009	0.960	0.984	0.944	0.975	1.000	0.959	1.021
16	6.00	0.974	1.006	0.974	0.989	0.963	0.984	1.000	0.973	1.014
17	8.00	0.976	1.005	0.976	0.990	0.966	0.985	1.000	0.976	1.012
18	10.00	0.975	1.005	0.975	0.990	0.965	0.985	1.000	0.975	1.013
19	12.00	0.994	1.001	0.994	0.998	0.992	0.996	1.000	0.994	1.003
20	14.00	1.047	0.990	1.047	1.019	1.067	1.028	1.000	1.048	0.977
21	16.00	1.064	0.987	1.064	1.025	1.092	1.039	1.000	1.065	0.969
22	18.00	0.971	1.006	0.971	0.988	0.959	0.982	1.000	0.971	1.015
23	20.00	0.794	1.049	0.794	0.911	0.721	0.869	1.001	0.792	1.126
24	22.00	0.581	1.119	0.581	0.803	0.464	0.718	1.003	0.578	1.321
25	24.00	0.539	1.137	0.539	0.779	0.417	0.686	1.003	0.536	1.372

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1459, RUN 1669, STATION 24 inches

MACH = 9.91 P0 = 3500. psia T0 = 1290. degF PTAVG = 11.65 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
9.91	6.313	89.1	9.18E-02	5.38E+06	4666.	2.69E-03	4.27E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.800	1.049	0.800	0.913	0.727	0.873	1.002	0.796	1.123
2	-22.00	0.968	1.007	0.968	0.987	0.954	0.980	1.000	0.967	1.017
3	-20.00	1.004	0.999	1.004	1.002	1.006	1.002	1.000	1.004	0.998
4	-18.00	0.993	1.002	0.993	0.997	0.990	0.996	1.000	0.993	1.004
5	-16.00	0.994	1.001	0.994	0.997	0.991	0.996	1.000	0.993	1.003
6	-14.00	0.981	1.004	0.981	0.992	0.973	0.988	1.000	0.980	1.010
7	-12.00	0.987	1.003	0.987	0.995	0.981	0.992	1.000	0.986	1.007
8	-10.00	0.976	1.005	0.976	0.990	0.967	0.986	1.000	0.976	1.012
9	-8.00	0.973	1.006	0.973	0.989	0.962	0.983	1.000	0.972	1.014
10	-6.00	0.972	1.006	0.972	0.989	0.960	0.983	1.000	0.972	1.015
11	-4.00	0.956	1.010	0.956	0.982	0.938	0.973	1.000	0.955	1.024
12	-2.00	0.954	1.010	0.954	0.981	0.935	0.972	1.000	0.953	1.025
13	0.00	0.962	1.008	0.962	0.984	0.946	0.977	1.000	0.961	1.020
14	2.00	0.952	1.010	0.952	0.980	0.933	0.971	1.001	0.951	1.026
15	4.00	0.957	1.010	0.957	0.982	0.939	0.973	1.000	0.956	1.023
16	6.00	0.973	1.006	0.973	0.989	0.962	0.983	1.000	0.972	1.014
17	8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	10.00	0.975	1.006	0.975	0.990	0.964	0.984	1.000	0.974	1.013
19	12.00	0.986	1.003	0.986	0.994	0.980	0.991	1.000	0.986	1.007
20	14.00	0.986	1.003	0.986	0.994	0.980	0.991	1.000	0.986	1.007
21	16.00	1.000	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000
22	18.00	1.007	0.998	1.007	1.003	1.010	1.004	1.000	1.007	0.996
23	20.00	1.012	0.997	1.012	1.005	1.018	1.008	1.000	1.013	0.994
24	22.00	0.986	1.003	0.986	0.994	0.980	0.991	1.000	0.986	1.007
25	24.00	0.821	1.043	0.821	0.923	0.755	0.887	1.002	0.818	1.108

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1459, RUN 1670, STATION 24 inches

MACH = 10.59   P0 = 7250. psia   T0 = 1340. degF   PTAVG = 19.20 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.59	10.408	82.6	1.33E-01	9.29E+06	4799.	4.18E-03	3.47E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	1.045	0.991	1.045	1.018	1.065	1.027	1.000	1.046	0.977
2	-22.00	1.220	0.959	1.220	1.084	1.327	1.129	0.998	1.224	0.902
3	-20.00	1.107	0.979	1.107	1.042	1.156	1.064	0.999	1.109	0.949
4	-18.00	1.010	0.998	1.010	1.004	1.014	1.006	1.000	1.010	0.995
5	-16.00	1.296	0.946	1.296	1.111	1.447	1.171	0.998	1.302	0.874
6	-14.00	1.265	0.951	1.265	1.101	1.398	1.154	0.998	1.271	0.885
7	-12.00	1.262	0.952	1.262	1.099	1.393	1.152	0.998	1.267	0.886
8	-10.00	1.247	0.954	1.246	1.094	1.369	1.144	0.998	1.251	0.892
9	-8.00	1.255	0.953	1.255	1.097	1.383	1.149	0.998	1.260	0.889
10	-6.00	1.258	0.952	1.258	1.098	1.387	1.150	0.998	1.263	0.888
11	-4.00	1.231	0.957	1.231	1.088	1.345	1.135	0.998	1.236	0.898
12	-2.00	1.229	0.957	1.229	1.088	1.342	1.134	0.998	1.234	0.899
13	0.00	1.232	0.956	1.232	1.089	1.347	1.136	0.998	1.237	0.897
14	2.00	1.233	0.956	1.233	1.089	1.348	1.136	0.998	1.238	0.897
15	4.00	1.236	0.956	1.235	1.090	1.352	1.138	0.998	1.240	0.896
16	6.00	1.246	0.954	1.246	1.094	1.368	1.143	0.998	1.251	0.892
17	8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	10.00	1.251	0.953	1.251	1.096	1.376	1.146	0.998	1.256	0.890
19	12.00	1.270	0.950	1.270	1.102	1.406	1.157	0.998	1.275	0.884
20	14.00	1.266	0.951	1.266	1.101	1.400	1.155	0.998	1.272	0.885
21	16.00	1.292	0.947	1.291	1.110	1.440	1.169	0.998	1.298	0.876
22	18.00	0.990	1.002	0.990	0.996	0.986	0.994	1.000	0.990	1.005
23	20.00	1.174	0.966	1.174	1.068	1.257	1.103	0.998	1.177	0.920
24	22.00	1.122	0.976	1.121	1.048	1.177	1.072	0.999	1.124	0.942
25	24.00	0.997	1.001	0.997	0.999	0.995	0.998	1.000	0.997	1.002

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1459, RUN 1671, STATION 24 inches

MACH = 10.10 P0 = 8000. psia T0 = 1350. degF PTAVG = 26.85 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.10	14.544	91.2	2.03E-01	1.17E+07	4813.	5.81E-03	2.95E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.802	1.048	0.802	0.914	0.730	0.874	1.002	0.799	1.121
2	-22.00	0.977	1.005	0.977	0.991	0.968	0.986	1.000	0.977	1.012
3	-20.00	1.018	0.996	1.018	1.007	1.025	1.011	1.000	1.018	0.991
4	-18.00	1.006	0.999	1.006	1.002	1.008	1.004	1.000	1.006	0.997
5	-16.00	1.003	0.999	1.003	1.001	1.004	1.002	1.000	1.003	0.999
6	-14.00	0.977	1.005	0.977	0.991	0.963	0.986	1.000	0.977	1.012
7	-12.00	0.973	1.006	0.973	0.989	0.962	0.983	1.000	0.973	1.014
8	-10.00	0.967	1.007	0.967	0.987	0.954	0.980	1.000	0.967	1.017
9	-8.00	0.975	1.005	0.975	0.990	0.965	0.985	1.000	0.975	1.013
10	-6.00	0.976	1.005	0.976	0.990	0.966	0.985	1.000	0.976	1.013
11	-4.00	0.962	1.008	0.962	0.984	0.947	0.977	1.000	0.962	1.020
12	-2.00	0.956	1.010	0.956	0.982	0.938	0.973	1.000	0.955	1.024
13	0.00	0.964	1.008	0.964	0.985	0.950	0.978	1.000	0.964	1.019
14	2.00	0.958	1.009	0.958	0.983	0.941	0.974	1.000	0.957	1.022
15	4.00	0.964	1.008	0.964	0.985	0.949	0.978	1.000	0.963	1.019
16	6.00	0.964	1.008	0.964	0.985	0.949	0.978	1.000	0.963	1.019
17	8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	10.00	0.967	1.007	0.967	0.987	0.954	0.980	1.000	0.967	1.017
19	12.00	0.974	1.006	0.974	0.989	0.963	0.984	1.000	0.974	1.014
20	14.00	0.977	1.005	0.977	0.991	0.968	0.986	1.000	0.977	1.012
21	16.00	0.993	1.002	0.993	0.997	0.990	0.996	1.000	0.993	1.004
22	18.00	0.994	1.001	0.994	0.998	0.992	0.996	1.000	0.994	1.003
23	20.00	1.011	0.998	1.011	1.005	1.016	1.007	1.000	1.012	0.994
24	22.00	0.992	1.002	0.992	0.997	0.988	0.995	1.000	0.991	1.004
25	24.00	0.844	1.037	0.845	0.934	0.786	0.902	1.002	0.842	1.091

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1459, RUN 1672, STATION 24 inches

MACH = 9.64 PO = 580. psia TO = 1140. degF PTAVG = 2.07 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
9.64	1.123	84.0	1.73E-02	1.07E+06	4405.	5.36E-04	9.30E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.635	1.102	0.635	0.831	0.523	0.758	1.005	0.629	1.266
2	-22.00	0.855	1.034	0.855	0.938	0.799	0.909	1.002	0.852	1.085
3	-20.00	0.980	1.004	0.980	0.992	0.971	0.988	1.000	0.979	1.011
4	-18.00	0.994	1.001	0.994	0.997	0.991	0.996	1.000	0.994	1.003
5	-16.00	0.986	1.003	0.986	0.994	0.980	0.991	1.000	0.986	1.007
6	-14.00	0.976	1.005	0.976	0.990	0.966	0.985	1.000	0.975	1.013
7	-12.00	0.976	1.005	0.976	0.990	0.966	0.985	1.000	0.975	1.013
8	-10.00	0.977	1.005	0.977	0.990	0.967	0.986	1.000	0.976	1.012
9	-8.00	0.979	1.005	0.979	0.991	0.971	0.987	1.000	0.979	1.011
10	-6.00	0.979	1.005	0.979	0.991	0.970	0.987	1.000	0.978	1.011
11	-4.00	0.967	1.007	0.967	0.986	0.954	0.980	1.000	0.967	1.017
12	-2.00	0.969	1.007	0.969	0.987	0.956	0.981	1.000	0.969	1.016
13	0.00	0.972	1.006	0.972	0.988	0.960	0.983	1.000	0.971	1.015
14	2.00	0.971	1.006	0.971	0.988	0.959	0.982	1.000	0.970	1.015
15	4.00	0.966	1.008	0.966	0.986	0.951	0.979	1.000	0.965	1.018
16	6.00	0.979	1.005	0.979	0.991	0.971	0.987	1.000	0.979	1.011
17	8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	10.00	0.979	1.005	0.979	0.991	0.971	0.987	1.000	0.979	1.011
19	12.00	0.942	1.013	0.942	0.976	0.918	0.964	1.001	0.941	1.031
20	14.00	0.990	1.002	0.990	0.996	0.986	0.994	1.000	0.990	1.005
21	16.00	0.996	1.001	0.996	0.998	0.994	0.998	1.000	0.996	1.002
22	18.00	1.006	0.999	1.006	1.003	1.009	1.004	1.000	1.006	0.997
23	20.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.003
24	22.00	0.883	1.027	0.883	0.951	0.838	0.927	1.001	0.881	1.067
25	24.00	0.646	1.098	0.646	0.837	0.536	0.766	1.004	0.640	1.255

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1459, RUN 1674, STATION 24 inches

MACH = 9.91 PO = 3600. psia TO = 1290. degF PTAVG = 12.04 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
9.91	6.522	89.2	9.49E-02	5.55E+06	4667.	2.77E-03	4.21E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.760	1.060	0.760	0.894	0.676	0.846	1.003	0.756	1.153
2	-22.00	0.949	1.011	0.949	0.979	0.927	0.968	1.001	0.948	1.028
3	-20.00	0.999	1.000	0.999	1.000	0.999	0.999	1.000	0.999	1.000
4	-18.00	0.991	1.002	0.991	0.996	0.987	0.994	1.000	0.991	1.005
5	-16.00	0.990	1.002	0.990	0.996	0.986	0.994	1.000	0.990	1.005
6	-14.00	0.975	1.005	0.975	0.990	0.965	0.985	1.000	0.975	1.013
7	-12.00	0.983	1.004	0.983	0.993	0.975	0.989	1.000	0.982	1.009
8	-10.00	0.971	1.006	0.971	0.988	0.959	0.982	1.000	0.970	1.015
9	-8.00	0.968	1.007	0.968	0.987	0.955	0.981	1.000	0.968	1.017
10	-6.00	0.966	1.007	0.966	0.986	0.952	0.979	1.000	0.965	1.018
11	-4.00	0.949	1.011	0.949	0.979	0.929	0.969	1.001	0.948	1.027
12	-2.00	0.950	1.011	0.950	0.979	0.930	0.969	1.001	0.949	1.027
13	0.00	0.953	1.010	0.954	0.981	0.934	0.971	1.000	0.953	1.025
14	2.00	0.948	1.012	0.948	0.978	0.926	0.968	1.001	0.947	1.028
15	4.00	0.953	1.010	0.953	0.980	0.933	0.971	1.000	0.952	1.025
16	6.00	0.965	1.008	0.965	0.986	0.951	0.979	1.000	0.964	1.019
17	8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	10.00	0.971	1.006	0.971	0.988	0.959	0.982	1.000	0.970	1.015
19	12.00	0.987	1.003	0.987	0.995	0.981	0.992	1.000	0.986	1.007
20	14.00	0.987	1.003	0.987	0.995	0.981	0.992	1.000	0.986	1.007
21	16.00	1.002	0.999	1.002	1.001	1.004	1.002	1.000	1.003	0.999
22	18.00	1.009	0.998	1.009	1.004	1.013	1.006	1.000	1.009	0.995
23	20.00	1.014	0.997	1.014	1.006	1.020	1.009	1.000	1.014	0.993
24	22.00	0.981	1.004	0.981	0.992	0.973	0.988	1.000	0.981	1.010
25	24.00	0.791	1.051	0.791	0.909	0.716	0.867	1.002	0.788	1.129

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1459, RUN 1678, STATION 24 inches

MACH = 10.23   PO = 8250. psia   TO = 1350. degF   PTAVG = 26.31 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.23	14.255	89.3	1.95E-01	1.17E+07	4819.	5.68E-03	2.98E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.797	1.049	0.798	0.912	0.724	0.871	1.002	0.794	1.124
2	-22.00	0.968	1.007	0.968	0.987	0.954	0.980	1.000	0.967	1.017
3	-20.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	-18.00	1.003	0.999	1.003	1.001	1.004	1.002	1.000	1.003	0.999
5	-16.00	0.993	1.001	0.993	0.997	0.990	0.996	1.000	0.993	1.004
6	-14.00	0.972	1.006	0.972	0.988	0.960	0.983	1.000	0.971	1.015
7	-12.00	0.970	1.006	0.970	0.988	0.958	0.982	1.000	0.970	1.016
8	-10.00	0.962	1.008	0.962	0.984	0.946	0.976	1.000	0.961	1.020
9	-8.00	0.965	1.008	0.965	0.986	0.951	0.979	1.000	0.965	1.018
10	-6.00	0.969	1.007	0.969	0.987	0.956	0.981	1.000	0.969	1.016
11	-4.00	0.951	1.011	0.951	0.980	0.931	0.970	1.000	0.950	1.026
12	-2.00	0.948	1.011	0.948	0.978	0.927	0.968	1.001	0.947	1.028
13	0.00	0.950	1.011	0.950	0.979	0.929	0.969	1.000	0.949	1.027
14	2.00	0.951	1.011	0.951	0.980	0.930	0.970	1.000	0.950	1.027
15	4.00	0.954	1.010	0.954	0.981	0.936	0.972	1.000	0.954	1.024
16	6.00	0.962	1.008	0.962	0.984	0.946	0.977	1.000	0.961	1.020
17	8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	10.00	0.967	1.007	0.967	0.986	0.953	0.979	1.000	0.966	1.018
19	12.00	0.977	1.005	0.977	0.991	0.968	0.986	1.000	0.977	1.012
20	14.00	0.975	1.005	0.975	0.990	0.965	0.985	1.000	0.975	1.013
21	16.00	0.992	1.002	0.992	0.997	0.988	0.993	1.000	0.991	1.004
22	18.00	0.997	1.001	0.997	0.999	0.996	0.998	1.000	0.997	1.001
23	20.00	1.014	0.997	1.014	1.006	1.020	1.008	1.000	1.014	0.993
24	22.00	0.994	1.001	0.994	0.997	0.991	0.996	1.000	0.993	1.003
25	24.00	0.834	1.040	0.834	0.929	0.772	0.895	1.002	0.831	1.099

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1459, RUN 1679, STATION 24 inches

MACH = 10.16 PO = 7800. psia TO = 1300. degF PTAVG = 25.60 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.16	13.872	87.5	1.92E-01	1.18E+07	4740.	5.72E-03	2.95E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.787	1.052	0.787	0.907	0.710	0.864	1.002	0.783	1.132
2	-22.00	0.964	1.008	0.964	0.985	0.949	0.978	1.000	0.964	1.019
3	-20.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	-18.00	1.008	0.998	1.008	1.003	1.011	1.005	1.000	1.008	0.996
5	-16.00	0.994	1.001	0.994	0.998	0.991	0.996	1.000	0.994	1.003
6	-14.00	0.970	1.007	0.970	0.988	0.957	0.981	1.000	0.969	1.016
7	-12.00	0.966	1.007	0.966	0.986	0.952	0.979	1.000	0.966	1.018
8	-10.00	0.955	1.010	0.955	0.982	0.937	0.972	1.000	0.954	1.024
9	-8.00	0.957	1.009	0.957	0.982	0.940	0.974	1.000	0.956	1.023
10	-6.00	0.959	1.009	0.959	0.983	0.942	0.975	1.000	0.958	1.022
11	-4.00	0.942	1.013	0.942	0.976	0.919	0.964	1.001	0.941	1.031
12	-2.00	0.938	1.014	0.938	0.974	0.913	0.962	1.001	0.937	1.034
13	0.00	0.940	1.013	0.940	0.975	0.915	0.963	1.001	0.939	1.033
14	2.00	0.939	1.013	0.939	0.975	0.915	0.963	1.001	0.938	1.033
15	4.00	0.944	1.012	0.944	0.977	0.921	0.965	1.001	0.943	1.031
16	6.00	0.952	1.011	0.952	0.980	0.932	0.970	1.000	0.951	1.026
17	8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	10.00	0.955	1.010	0.955	0.982	0.937	0.972	1.000	0.954	1.024
19	12.00	0.965	1.008	0.965	0.986	0.951	0.979	1.000	[illegible]	1.018
20	14.00	0.965	1.008	0.965	0.985	0.950	0.978	1.000	0.964	1.019
21	16.00	0.984	1.003	0.984	0.993	0.977	0.990	1.000	0.983	1.009
22	18.00	0.992	1.002	0.992	0.997	0.989	0.995	1.000	0.992	1.004
23	20.00	1.009	0.998	1.009	1.004	1.013	1.006	1.000	1.009	0.995
24	22.00	0.978	1.005	0.978	0.991	0.968	0.986	1.000	0.977	1.012
25	24.00	0.801	1.048	0.802	0.914	0.730	0.874	1.002	0.798	1.121

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1459, RUN 1680, STATION 24 inches

MACH = 10.46   P0 = 11600. psia   T0 = 1320. degF   PTAVG = 36.16 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.46	19.595	85.6	2.56E-01	1.68E+07	4825.	7.79E-03	2.55E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.774	1.056	0.774	0.901	0.695	0.855	1.002	0.771	1.142
2	-22.00	0.960	1.009	0.960	0.983	0.943	0.975	1.000	0.959	1.021
3	-20.00	1.016	0.997	1.016	1.006	1.023	1.010	1.000	1.016	0.992
4	-18.00	1.004	0.999	1.004	1.002	1.006	1.003	1.000	1.005	0.998
5	-16.00	1.003	0.999	1.003	1.001	1.004	1.002	1.000	1.003	0.999
6	-14.00	0.997	1.001	0.997	0.999	0.996	0.998	1.000	0.997	1.002
7	-12.00	0.989	1.002	0.990	0.996	0.985	0.994	1.000	0.989	1.005
8	-10.00	0.976	1.005	0.977	0.990	0.967	0.986	1.000	0.976	1.012
9	-8.00	0.980	1.004	0.980	0.992	0.971	0.987	1.000	0.979	1.011
10	-6.00	0.972	1.006	0.972	0.988	0.960	0.983	1.000	0.971	1.015
11	-4.00	0.963	1.008	0.963	0.985	0.948	0.977	1.000	0.963	1.020
12	-2.00	0.954	1.010	0.954	0.981	0.935	0.972	1.000	0.953	1.025
13	0.00	0.959	1.009	0.959	0.983	0.941	0.975	1.000	0.958	1.022
14	2.00	0.955	1.010	0.955	0.981	0.936	0.972	1.000	0.954	1.024
15	4.00	0.967	1.007	0.967	0.986	0.953	0.980	1.000	0.967	1.017
16	6.00	0.968	1.007	0.968	0.987	0.955	0.980	1.000	0.967	1.017
17	8.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	10.00	0.981	1.004	0.981	0.992	0.973	0.988	1.000	0.980	1.010
19	12.00	0.988	1.003	0.988	0.995	0.983	0.993	1.000	0.988	1.006
20	14.00	1.002	1.000	1.002	1.001	1.002	1.001	1.000	1.002	0.999
21	16.00	1.006	0.999	1.006	1.002	1.009	1.004	1.000	1.006	0.997
22	18.00	0.996	1.001	0.996	0.998	0.994	0.997	1.000	0.995	1.002
23	20.00	1.005	0.999	1.005	1.002	1.007	1.003	1.000	1.005	0.998
24	22.00	0.970	1.006	0.970	0.988	0.958	0.982	1.000	0.970	1.016
25	24.00	0.796	1.050	0.796	0.911	0.723	0.870	1.002	0.793	1.125

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1605, RUN 2240, STATION -12 inches

MACH = 14.19 PO = 20100. psia TO = 2660. degF PTAVG = 12.66 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
14.19	6.871	89.0	4.88E-02	4.10E+06	6673.	1.43E-03	7.01E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.498	1.154	0.499	0.755	0.374	0.654	1.003	0.496	1.427
2	-22.00	0.733	1.066	0.733	0.882	0.645	0.828	1.001	0.731	1.172
3	-20.00	0.919	1.018	0.919	0.966	0.887	0.950	1.000	0.918	1.044
4	-18.00	0.991	1.002	0.991	0.996	0.988	0.995	1.000	0.991	1.004
5	-16.00	0.998	1.000	0.998	0.999	0.997	0.999	1.000	0.998	1.001
6	-14.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.002
7	-12.00	0.994	1.001	0.994	0.997	0.991	0.996	1.000	0.994	1.003
8	-10.00	0.984	1.003	0.984	0.994	0.978	0.990	1.000	0.984	1.008
9	-8.00	0.979	1.004	0.979	0.992	0.971	0.987	1.000	0.979	1.011
10	-6.00	0.981	1.004	0.981	0.992	0.973	0.988	1.000	0.981	1.010
11	-4.00	0.963	1.008	0.963	0.985	0.948	0.977	1.000	0.963	1.020
12	-2.00	0.964	1.008	0.964	0.985	0.949	0.978	1.000	0.963	1.019
13	0.00	0.916	1.018	0.916	0.965	0.884	0.948	1.000	0.916	1.046
14	2.00	0.953	1.010	0.953	0.981	0.934	0.971	1.000	0.952	1.025
15	4.00	0.977	1.005	0.977	0.991	0.968	0.986	1.000	0.977	1.012
16	6.00	0.980	1.004	0.980	0.992	0.972	0.988	1.000	0.980	1.010
17	8.00	0.978	1.005	0.978	0.991	0.969	0.986	1.000	0.978	1.012
18	10.00	0.988	1.002	0.983	0.995	0.983	0.993	1.000	0.988	1.006
19	12.00	0.996	1.001	0.996	0.998	0.994	0.998	1.000	0.996	1.002
20	14.00	1.005	0.999	1.005	1.002	1.007	1.003	1.000	1.005	0.998
21	16.00	1.002	1.000	1.002	1.001	1.003	1.001	1.000	1.002	0.999
22	18.00	0.998	1.000	0.998	0.999	0.998	0.999	1.000	0.998	1.001
23	20.00	0.944	1.012	0.944	0.977	0.922	0.965	1.000	0.943	1.030
24	22.00	0.771	1.055	0.772	0.901	0.693	0.854	1.001	0.770	1.142
25	24.00	0.524	1.143	0.524	0.770	0.401	0.674	1.003	0.521	1.391

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1605, RUN 2241, STATION 72 inches

MACH = 14.16   P0 = 19500. psia   T0 = 2880. degF   PTAVG = 11.79 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
14.16	6.398	95.8	4.56E-02	3.43E+06	6908.	1.24E-03	7.64E-03

PPOFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.545	1.133	0.545	0.783	0.424	0.691	1.003	0.542	1.364
2	-22.00	0.737	1.065	0.737	0.884	0.650	0.830	1.001	0.735	1.169
3	-20.00	0.948	1.011	0.948	0.979	0.928	0.968	1.000	0.948	1.028
4	-18.00	1.011	0.998	1.011	1.004	1.016	1.007	1.000	1.011	0.994
5	-16.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6	-14.00	0.996	1.001	0.996	0.998	0.994	0.997	1.000	0.996	1.002
7	-12.00	0.986	1.003	0.986	0.994	0.980	0.991	1.000	0.985	1.007
8	-10.00	0.993	1.001	0.993	0.997	0.990	0.996	1.000	0.993	1.003
9	-8.00	0.963	1.008	0.963	0.985	0.948	0.977	1.000	0.962	1.020
10	-6.00	0.963	1.008	0.963	0.985	0.948	0.977	1.000	0.962	1.020
11	-4.00	0.957	1.009	0.957	0.982	0.939	0.973	1.000	0.956	1.023
12	-2.00	0.966	1.007	0.966	0.986	0.952	0.979	1.000	0.966	1.018
13	0.00	0.962	1.008	0.962	0.984	0.947	0.977	1.000	0.961	1.020
14	2.00	0.981	1.004	0.981	0.992	0.974	0.989	1.000	0.981	1.010
15	4.00	0.961	1.008	0.961	0.984	0.945	0.976	1.000	0.961	1.021
16	6.00	0.970	1.006	0.970	0.988	0.958	0.982	1.000	0.970	1.016
17	8.00	0.970	1.006	0.970	0.988	0.958	0.982	1.000	0.970	1.016
18	10.00	0.997	1.001	0.997	0.999	0.995	0.998	1.000	0.997	1.002
19	12.00	1.001	1.000	1.001	1.000	1.001	1.001	1.000	1.001	1.000
20	14.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	16.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	18.00	1.015	0.997	1.015	1.006	1.022	1.009	1.000	1.015	0.992
23	20.00	0.967	1.007	0.967	0.987	0.954	0.980	1.000	0.967	1.017
24	22.00	0.761	1.058	0.761	0.896	0.680	0.847	1.001	0.759	1.150
25	24.00	0.556	1.128	0.557	0.789	0.437	0.700	1.003	0.554	1.349

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1605, RUN 2242, STATION 48 inches

MACH = 14.30 PO = 19750. psia TO = 2610. degF PTAVG = 12.03 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
14.30	6.532	86.0	4.56E-02	4.06E+06	6614.	1.38E-03	7.09E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.525	1.142	0.526	0.771	0.403	0.676	1.003	0.523	1.389
2	-22.00	0.765	1.057	0.765	0.897	0.685	0.849	1.001	0.763	1.147
3	-20.00	0.943	1.012	0.943	0.977	0.921	0.965	1.000	0.943	1.030
4	-18.00	1.004	0.999	1.004	1.002	1.005	1.002	1.000	1.004	0.998
5	-16.00	1.004	0.999	1.004	1.002	1.005	1.002	1.000	1.004	0.998
6	-14.00	0.996	1.001	0.996	0.998	0.995	0.998	1.000	0.996	1.002
7	-12.00	0.995	1.001	0.995	0.998	0.994	0.997	1.000	0.995	1.002
8	-10.00	0.990	1.002	0.990	0.996	0.985	0.994	1.000	0.989	1.005
9	-8.00	1.014	0.997	1.014	1.006	1.019	1.008	1.000	1.014	0.993
10	-6.00	0.971	1.006	0.971	0.988	0.960	0.982	1.000	0.971	1.015
11	-4.00	0.948	1.011	0.948	0.979	0.927	0.968	1.000	0.948	1.028
12	-2.00	0.949	1.011	0.949	0.979	0.929	0.969	1.000	0.948	1.027
13	0.00	0.912	1.019	0.912	0.963	0.877	0.945	1.000	0.911	1.049
14	2.00	0.929	1.015	0.929	0.971	0.901	0.956	1.000	0.928	1.038
15	4.00	0.952	1.010	0.952	0.980	0.933	0.971	1.000	0.952	1.025
16	6.00	0.967	1.007	0.967	0.987	0.954	0.980	1.000	0.967	1.017
17	8.00	1.001	1.000	1.001	1.001	1.002	1.001	1.000	1.001	0.999
18	10.00	1.013	0.997	1.013	1.005	1.018	1.008	1.000	1.013	0.993
19	12.00	1.000	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000
20	14.00	0.994	1.001	0.994	0.997	0.991	0.996	1.000	0.994	1.003
21	16.00	0.996	1.001	0.996	0.998	0.995	0.998	1.000	0.996	1.002
22	18.00	1.005	0.999	1.005	1.002	1.008	1.003	1.000	1.005	0.997
23	20.00	0.951	1.011	0.951	0.980	0.931	0.970	1.000	0.950	1.026
24	22.00	0.787	1.051	0.787	0.908	0.713	0.864	1.001	0.786	1.130
25	24.00	0.534	1.138	0.535	0.777	0.413	0.683	1.003	0.532	1.377

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1605, RUN 2243, STATION 24 inches

MACH = 14.45 P0 = 20200. psia T0 = 2375. degF PTAVG = 12.38 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
14.45	6.716	77.7	4.59E-02	4.81E+06	6353.	1.54E-03	6.59E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.526	1.141	0.526	0.772	0.404	0.676	1.003	0.523	1.388
2	-22.00	0.740	1.064	0.740	0.886	0.653	0.832	1.001	0.738	1.166
3	-20.00	0.927	1.016	0.927	0.970	0.898	0.955	1.000	0.926	1.040
4	-18.00	1.003	0.999	1.003	1.001	1.004	1.002	1.000	1.003	0.999
5	-16.00	1.004	0.999	1.004	1.001	1.005	1.002	1.000	1.004	0.998
6	-14.00	1.008	0.998	1.008	1.003	1.012	1.005	1.000	1.009	0.996
7	-12.00	0.996	1.001	0.996	0.998	0.994	0.997	1.000	0.996	1.002
8	-10.00	1.004	0.999	1.004	1.001	1.005	1.002	1.000	1.004	0.998
9	-8.00	1.000	1.000	1.000	1.000	0.999	1.000	1.000	1.000	1.000
10	-6.00	1.013	0.997	1.013	1.005	1.018	1.008	1.000	1.013	0.994
11	-4.00	0.961	1.008	0.961	0.984	0.945	0.976	1.000	0.960	1.021
12	-2.00	0.925	1.016	0.925	0.969	0.896	0.954	1.000	0.925	1.040
13	0.00	0.905	1.021	0.905	0.961	0.869	0.941	1.000	0.904	1.052
14	2.00	0.925	1.016	0.925	0.969	0.896	0.954	1.000	0.925	1.040
15	4.00	0.946	1.011	0.946	0.978	0.925	0.967	1.000	0.946	1.029
16	6.00	1.002	1.000	1.002	1.001	1.003	1.001	1.000	1.002	0.999
17	8.00	1.003	0.999	1.003	1.001	1.004	1.002	1.000	1.003	0.999
18	10.00	1.009	0.998	1.009	1.004	1.013	1.006	1.000	1.009	0.995
19	12.00	1.009	0.998	1.009	1.004	1.013	1.006	1.000	1.009	0.995
20	14.00	1.005	0.999	1.005	1.002	1.007	1.003	1.000	1.005	0.997
21	16.00	0.996	1.001	0.996	0.999	0.995	0.998	1.000	0.996	1.002
22	18.00	1.013	0.997	1.013	1.005	1.019	1.008	1.000	1.013	0.993
23	20.00	0.954	1.010	0.954	0.981	0.935	0.971	1.000	0.953	1.025
24	22.00	0.773	1.055	0.773	0.901	0.695	0.855	1.001	0.771	1.141
25	24.00	0.547	1.132	0.547	0.784	0.427	0.693	1.003	0.544	1.361

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1605, RUN 2244, STATION 12 inches

MACH = 14.42 PO = 20200. psia TO = 2375. degF PTAVG = 12.51 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
14.42	6.790	78.1	4.67E-02	4.84E+06	6353.	1.56E-03	6.56E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.520	1.144	0.521	0.769	0.398	0.672	1.003	0.518	1.395
2	-22.00	0.734	1.066	0.734	0.883	0.646	0.828	1.001	0.732	1.171
3	-20.00	0.922	1.017	0.922	0.968	0.891	0.952	1.000	0.921	1.043
4	-18.00	0.998	1.000	0.998	0.999	0.998	0.999	1.000	0.998	1.001
5	-16.00	1.004	0.999	1.004	1.002	1.006	1.002	1.000	1.004	0.998
6	-14.00	1.002	1.000	1.002	1.001	1.003	1.001	1.000	1.002	0.999
7	-12.00	0.996	1.001	0.996	0.998	0.994	0.998	1.000	0.996	1.002
8	-10.00	0.998	1.000	0.998	0.999	0.998	0.999	1.000	0.998	1.001
9	-8.00	0.994	1.001	0.994	0.998	0.992	0.997	1.000	0.994	1.003
10	-6.00	0.987	1.003	0.987	0.995	0.982	0.992	1.000	0.987	1.007
11	-4.00	0.972	1.006	0.972	0.989	0.961	0.983	1.000	0.972	1.015
12	-2.00	0.922	1.017	0.922	0.968	0.891	0.952	1.000	0.921	1.043
13	0.00	0.917	1.018	0.917	0.966	0.885	0.949	1.000	0.916	1.045
14	2.00	0.921	1.017	0.921	0.967	0.890	0.951	1.000	0.920	1.043
15	4.00	0.953	1.010	0.953	0.981	0.934	0.971	1.000	0.952	1.025
16	6.00	0.986	1.003	0.986	0.994	0.981	0.992	1.000	0.986	1.007
17	8.00	0.999	1.000	0.999	1.000	0.999	1.000	1.000	0.999	1.000
18	10.00	0.998	1.000	0.998	0.999	0.997	0.999	1.000	0.998	1.001
19	12.00	1.007	0.999	1.007	1.003	1.010	1.004	1.000	1.007	0.996
20	14.00	1.002	1.000	1.002	1.001	1.003	1.001	1.000	1.002	0.999
21	16.00	0.996	1.001	0.996	0.998	0.994	0.998	1.000	0.996	1.002
22	18.00	1.006	0.999	1.006	1.002	1.008	1.003	1.000	1.006	0.997
23	20.00	0.950	1.011	0.950	0.980	0.931	0.970	1.000	0.950	1.026
24	22.00	0.764	1.057	0.764	0.897	0.684	0.849	1.001	0.762	1.147
25	24.00	0.532	1.139	0.533	0.776	0.411	0.681	1.003	0.530	1.379

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1605, RUN 2247, STATION 0 inches

MACH = 10.43 PO = 13500. psia TO = 1220. degF PTAVG = 45.71 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.43	24.767	81.9	3.25E-01	2.28E+07	4704.	1.04E-02	2.19E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.749	1.063	0.749	0.889	0.662	0.838	1.003	0.745	1.161
2	-22.00	0.957	1.009	0.957	0.982	0.940	0.974	1.000	0.957	1.023
3	-20.00	1.008	0.998	1.008	1.003	1.012	1.005	1.000	1.008	0.996
4	-18.00	0.998	1.000	0.998	0.999	0.998	0.999	1.000	0.998	1.001
5	-16.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.003
6	-14.00	0.983	1.004	0.983	0.993	0.976	0.990	1.000	0.983	1.009
7	-12.00	0.998	1.000	0.998	0.999	0.997	0.999	1.000	0.998	1.001
8	-10.00	0.998	1.000	0.998	0.999	0.998	0.999	1.000	0.998	1.001
9	-8.00	1.008	0.998	1.008	1.003	1.011	1.005	1.000	1.008	0.996
10	-6.00	1.019	0.996	1.019	1.008	1.027	1.011	1.000	1.019	0.990
11	-4.00	1.024	0.995	1.024	1.010	1.035	1.015	1.000	1.025	0.988
12	-2.00	1.045	0.991	1.045	1.018	1.065	1.027	1.000	1.046	0.977
13	0.00	1.046	0.990	1.046	1.018	1.066	1.028	1.000	1.047	0.977
14	2.00	1.049	0.990	1.049	1.020	1.071	1.030	1.000	1.050	0.975
15	4.00	1.037	0.992	1.037	1.015	1.053	1.022	1.000	1.038	0.981
16	6.00	1.022	0.995	1.022	1.009	1.032	1.014	1.000	1.023	0.989
17	8.00	1.001	1.000	1.001	1.000	1.001	1.000	1.000	1.001	1.000
18	10.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
19	12.00	0.721	1.072	0.722	0.876	0.628	0.819	1.003	0.718	1.184
20	14.00	0.986	1.003	0.986	0.994	0.980	0.991	1.000	0.985	1.007
21	16.00	0.992	1.002	0.992	0.997	0.989	0.995	1.000	0.992	1.004
22	18.00	1.002	1.000	1.002	1.001	1.002	1.001	1.000	1.002	0.999
23	20.00	1.011	0.998	1.011	1.004	1.015	1.006	1.000	1.011	0.995
24	22.00	1.002	1.000	1.002	1.001	1.003	1.001	1.000	1.002	0.999
25	24.00	0.824	1.042	0.824	0.924	0.759	0.889	1.002	0.822	1.105

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1605, RUN 2248, STATION 24 inches

MACH = 10.45 PO = 14000. psia TO = 1255. degF PTAVG = 47.14 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.45	25.542	83.6	3.34E-01	2.27E+07	4762.	1.04E-02	2.19E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.702	1.078	0.703	0.866	0.605	0.806	1.003	0.698	1.200
2	-22.00	0.913	1.020	0.913	0.964	0.879	0.946	1.001	0.912	1.048
3	-20.00	0.984	1.003	0.984	0.994	0.978	0.990	1.000	0.984	1.008
4	-18.00	0.993	1.002	0.993	0.997	0.990	0.996	1.000	0.993	1.004
5	-16.00	0.988	1.002	0.988	0.995	0.984	0.993	1.000	0.988	1.006
6	-14.00	0.995	1.001	0.995	0.998	0.992	0.997	1.000	0.994	1.003
7	-12.00	0.996	1.001	0.996	0.998	0.994	0.997	1.000	0.996	1.002
8	-10.00	0.998	1.000	0.998	0.999	0.997	0.999	1.000	0.998	1.001
9	-8.00	0.996	1.001	0.997	0.999	0.995	0.998	1.000	0.996	1.002
10	-6.00	0.997	1.001	0.997	0.999	0.996	0.998	1.000	0.997	1.001
11	-4.00	0.997	1.001	0.997	0.999	0.995	0.998	1.000	0.997	1.002
12	-2.00	1.003	0.999	1.003	1.001	1.004	1.002	1.000	1.003	0.998
13	0.00	0.993	1.002	0.993	0.997	0.990	0.996	1.000	0.993	1.004
14	2.00	1.004	0.999	1.004	1.002	1.006	1.003	1.000	1.004	0.998
15	4.00	1.007	0.998	1.007	1.003	1.010	1.004	1.000	1.007	0.995
16	6.00	1.010	0.998	1.010	1.004	1.014	1.006	1.000	1.010	0.995
17	8.00	1.009	0.998	1.009	1.004	1.013	1.005	1.000	1.009	0.995
18	10.00	1.009	0.998	1.009	1.004	1.013	1.006	1.000	1.010	0.995
19	12.00	1.010	0.998	1.010	1.004	1.015	1.006	1.000	1.010	0.995
20	14.00	1.003	0.999	1.003	1.001	1.004	1.002	1.000	1.003	0.998
21	16.00	1.005	0.999	1.005	1.002	1.008	1.003	1.000	1.006	0.997
22	18.00	1.007	0.998	1.007	1.003	1.010	1.004	1.000	1.007	0.996
23	20.00	1.007	0.999	1.007	1.003	1.010	1.004	1.000	1.007	0.996
24	22.00	0.971	1.006	0.972	0.988	0.960	0.983	1.000	0.971	1.015
25	24.00	0.782	1.053	0.783	0.905	0.705	0.861	1.002	0.779	1.135

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2258, STATION 24 inches

MACH = 10.40 P0 = 14200. psia T0 = 1300. degF PTAVG = 48.62 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.40	26.343	86.8	3.48E-01	2.23E+07	4829.	1.05E-02	2.20E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.745	1.064	0.745	0.887	0.658	0.836	1.003	0.741	1.164
2	-22.00	0.941	1.013	0.941	0.975	0.917	0.963	1.001	0.940	1.032
3	-20.00	0.992	1.002	0.992	0.997	0.988	0.995	1.000	0.992	1.004
4	-18.00	1.002	1.000	1.002	1.001	1.003	1.001	1.000	1.002	0.999
5	-16.00	0.996	1.001	0.996	0.998	0.995	0.998	1.000	0.996	1.002
6	-14.00	0.996	1.001	0.996	0.999	0.995	0.998	1.000	0.996	1.002
7	-12.00	0.988	1.003	0.988	0.995	0.983	0.993	1.000	0.988	1.006
8	-10.00	0.993	1.001	0.993	0.997	0.990	0.996	1.000	0.993	1.004
9	-8.00	0.994	1.001	0.994	0.998	0.992	0.997	1.000	0.994	1.003
10	-6.00	0.982	1.004	0.982	0.993	0.975	0.989	1.000	0.982	1.009
11	-4.00	0.980	1.004	0.980	0.992	0.971	0.987	1.000	0.979	1.011
12	-2.00	0.973	1.006	0.973	0.989	0.962	0.984	1.000	0.973	1.014
13	0.00	0.959	1.009	0.959	0.983	0.942	0.975	1.000	0.958	1.022
14	2.00	0.970	1.007	0.970	0.988	0.957	0.981	1.000	0.969	1.016
15	4.00	0.976	1.005	0.976	0.990	0.966	0.985	1.000	0.975	1.013
16	6.00	0.990	1.002	0.990	0.996	0.986	0.994	1.000	0.990	1.005
17	8.00	0.994	1.001	0.994	0.997	0.991	0.996	1.000	0.994	1.003
18	10.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
19	12.00	0.988	1.003	0.988	0.995	0.982	0.992	1.000	0.987	1.007
20	14.00	0.985	1.003	0.985	0.994	0.979	0.991	1.000	0.985	1.008
21	16.00	0.988	1.003	0.988	0.995	0.983	0.993	1.000	0.988	1.006
22	18.00	0.998	1.000	0.998	0.999	0.997	0.999	1.000	0.998	1.001
23	20.00	0.981	1.004	0.981	0.992	0.973	0.988	1.000	0.980	1.010
24	22.00	0.927	1.016	0.927	0.970	0.898	0.955	1.001	0.926	1.040
25	24.00	0.741	1.066	0.741	0.885	0.652	0.833	1.003	0.737	1.168

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2259, STATION 66 inches

MACH = 10.37 PO = 14250. psia TO = 1320. degF PTAVG = 49.10 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.37	26.603	88.2	3.53E-01	2.20E+07	4858.	1.04E-02	2.21E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.705	1.077	0.706	0.868	0.609	0.808	1.003	0.701	1.198
2	-22.00	0.873	1.029	0.873	0.946	0.824	0.920	1.001	0.871	1.073
3	-20.00	0.986	1.003	0.986	0.994	0.980	0.992	1.000	0.986	1.007
4	-18.00	1.002	1.000	1.002	1.001	1.003	1.001	1.000	1.002	0.999
5	-16.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6	-14.00	0.997	1.001	0.997	0.999	0.996	0.998	1.000	0.997	1.001
7	-12.00	0.993	1.001	0.993	0.997	0.991	0.996	1.000	0.993	1.003
8	-10.00	0.987	1.003	0.987	0.995	0.981	0.992	1.000	0.986	1.007
9	-8.00	0.988	1.003	0.988	0.995	0.983	0.993	1.000	0.988	1.006
10	-6.00	0.981	1.004	0.981	0.992	0.972	0.988	1.000	0.980	1.010
11	-4.00	0.975	1.005	0.975	0.990	0.965	0.985	1.000	0.975	1.013
12	-2.00	0.960	1.009	0.960	0.984	0.944	0.976	1.000	0.960	1.021
13	0.00	0.954	1.010	0.954	0.981	0.935	0.971	1.000	0.953	1.025
14	2.00	0.959	1.009	0.959	0.983	0.942	0.975	1.000	0.958	1.022
15	4.00	0.971	1.006	0.971	0.988	0.959	0.982	1.000	0.971	1.015
16	6.00	0.969	1.007	0.969	0.987	0.956	0.981	1.000	0.968	1.017
17	8.00	0.969	1.007	0.969	0.987	0.956	0.981	1.000	0.968	1.017
18	10.00	0.979	1.005	0.979	0.991	0.970	0.987	1.000	0.978	1.011
19	12.00	0.986	1.003	0.986	0.994	0.981	0.992	1.000	0.986	1.007
20	14.00	0.990	1.002	0.990	0.996	0.985	0.994	1.000	0.990	1.005
21	16.00	0.993	1.002	0.993	0.997	0.990	0.996	1.000	0.993	1.004
22	18.00	0.998	1.000	0.998	0.999	0.997	0.999	1.000	0.998	1.001
23	20.00	0.984	1.003	0.984	0.994	0.978	0.990	1.000	0.984	1.008
24	22.00	0.873	1.029	0.873	0.946	0.824	0.920	1.001	0.871	1.073
25	24.00	0.740	1.066	0.740	0.885	0.651	0.832	1.003	0.736	1.169

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2260, STATION 108 inches

MACH = 10.43 PO = 14100. psia TO = 1300. degF PTAVG = 47.33 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
10.43	25.645	86.1	3.36E-01	2.18E+07	4829.	1.02E-02	2.23E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.742	1.065	0.743	0.886	0.654	0.834	1.003	0.739	1.166
2	-22.00	0.885	1.026	0.885	0.951	0.840	0.928	1.001	0.883	1.065
3	-20.00	0.934	1.015	0.934	0.973	0.907	0.959	1.001	0.933	1.036
4	-18.00	0.931	1.015	0.931	0.971	0.903	0.957	1.001	0.929	1.038
5	-16.00	1.018	0.996	1.018	1.007	1.026	1.011	1.000	1.019	0.991
6	-14.00	1.038	0.992	1.037	1.015	1.054	1.023	1.000	1.038	0.981
7	-12.00	1.027	0.994	1.026	1.011	1.038	1.016	1.000	1.027	0.987
8	-10.00	1.017	0.996	1.017	1.007	1.025	1.010	1.000	1.018	0.991
9	-8.00	1.011	0.998	1.011	1.004	1.016	1.007	1.000	1.011	0.994
10	-6.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	-4.00	1.005	0.999	1.005	1.002	1.007	1.003	1.000	1.005	0.998
12	-2.00	1.009	0.998	1.009	1.004	1.013	1.005	1.000	1.009	0.995
13	0.00	1.016	0.997	1.016	1.006	1.022	1.009	1.000	1.016	0.992
14	2.00	0.998	1.001	0.998	0.999	0.997	0.999	1.000	0.998	1.001
15	4.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.003
16	6.00	0.986	1.003	0.986	0.994	0.980	0.992	1.000	0.986	1.007
17	8.00	0.997	1.001	0.997	0.999	0.996	0.998	1.000	0.997	1.002
18	10.00	1.001	1.000	1.001	1.000	1.001	1.000	1.000	1.001	1.000
19	12.00	1.008	0.998	1.007	1.003	1.011	1.005	1.000	1.008	0.996
20	14.00	1.020	0.996	1.020	1.008	1.029	1.012	1.000	1.021	0.990
21	16.00	0.982	1.004	0.982	0.993	0.974	0.989	1.000	0.981	1.010
22	18.00	0.919	1.018	0.919	0.966	0.887	0.950	1.001	0.918	1.045
23	20.00	0.907	1.021	0.907	0.961	0.870	0.942	1.001	0.905	1.052
24	22.00	0.858	1.033	0.858	0.940	0.804	0.911	1.001	0.856	1.082
25	24.00	0.727	1.070	0.727	0.878	0.635	0.823	1.003	0.723	1.179

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2261, STATION 108 inches

MACH = 13.17 P0 = 2100. psia T0 = 2475. degF PTAVG = 1.53 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
13.17	0.829	90.0	6.83E-03	5.24E+05	6233.	1.98E-04	1.82E-02

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.381	1.221	0.381	0.677	0.256	0.556	1.005	0.378	1.638
2	-22.00	0.551	1.131	0.552	0.786	0.431	0.696	1.003	0.548	1.356
3	-20.00	0.742	1.064	0.742	0.886	0.656	0.834	1.002	0.740	1.165
4	-18.00	0.909	1.020	0.909	0.962	0.873	0.943	1.001	0.908	1.050
5	-16.00	0.985	1.003	0.985	0.994	0.979	0.991	1.000	0.985	1.008
6	-14.00	1.005	0.999	1.005	1.002	1.007	1.003	1.000	1.005	0.997
7	-12.00	0.970	1.006	0.970	0.988	0.957	0.981	1.000	0.969	1.016
8	-10.00	0.929	1.015	0.929	0.971	0.901	0.956	1.000	0.928	1.038
9	-8.00	0.924	1.016	0.924	0.969	0.895	0.953	1.000	0.924	1.041
10	-6.00	0.917	1.018	0.917	0.966	0.885	0.949	1.000	0.916	1.045
11	-4.00	0.898	1.023	0.898	0.957	0.858	0.936	1.001	0.897	1.057
12	-2.00	0.892	1.024	0.892	0.955	0.850	0.933	1.001	0.891	1.060
13	0.00	0.894	1.023	0.894	0.956	0.854	0.934	1.001	0.893	1.059
14	2.00	0.898	1.023	0.898	0.958	0.859	0.937	1.001	0.897	1.057
15	4.00	0.902	1.022	0.902	0.959	0.864	0.939	1.001	0.901	1.054
16	6.00	0.914	1.019	0.914	0.964	0.880	0.947	1.001	0.913	1.047
17	8.00	0.930	1.015	0.930	0.971	0.903	0.957	1.000	0.930	1.038
18	10.00	0.931	1.015	0.931	0.972	0.904	0.957	1.000	0.930	1.037
19	12.00	0.973	1.006	0.973	0.989	0.962	0.983	1.000	0.973	1.014
20	14.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.003
21	16.00	0.962	1.008	0.962	0.984	0.946	0.977	1.000	0.961	1.020
22	18.00	0.884	1.026	0.884	0.951	0.840	0.928	1.001	0.883	1.065
23	20.00	0.749	1.062	0.749	0.890	0.665	0.839	1.002	0.747	1.159
24	22.00	0.572	1.123	0.572	0.798	0.454	0.712	1.003	0.569	1.331
25	24.00	0.386	1.217	0.386	0.681	0.260	0.560	1.005	0.383	1.627

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2262, STATION 24 inches

MACH = 13.21 PO = 2100. psia TO = 2400. degF PTAVG = 1.52 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
13.21	0.825	87.0	6.75E-03	5.47E+05	6145.	2.02E-04	1.79E-02

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.360	1.235	0.360	0.662	0.236	0.537	1.005	0.357	1.686
2	-22.00	0.554	1.130	0.554	0.788	0.434	0.698	1.003	0.550	1.353
3	-20.00	0.796	1.049	0.796	0.912	0.724	0.870	1.001	0.794	1.124
4	-18.00	0.955	1.010	0.955	0.981	0.936	0.972	1.000	0.954	1.024
5	-16.00	0.996	1.001	0.996	0.998	0.994	0.998	1.000	0.996	1.002
6	-14.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	-12.00	0.997	1.001	0.997	0.999	0.996	0.998	1.000	0.997	1.001
8	-10.00	0.968	1.007	0.968	0.987	0.955	0.980	1.000	0.967	1.017
9	-8.00	0.963	1.008	0.963	0.985	0.948	0.977	1.000	0.963	1.019
10	-6.00	0.976	1.005	0.976	0.990	0.967	0.986	1.000	0.976	1.012
11	-4.00	0.964	1.008	0.965	0.985	0.950	0.978	1.000	0.964	1.019
12	-2.00	1.007	0.999	1.007	1.003	1.010	1.004	1.000	1.007	0.996
13	0.00	1.043	0.991	1.043	1.017	1.061	1.026	1.000	1.043	0.979
14	2.00	1.003	0.999	1.003	1.001	1.005	1.002	1.000	1.003	0.998
15	4.00	0.962	1.008	0.962	0.984	0.946	0.977	1.000	0.961	1.020
16	6.00	0.959	1.009	0.959	0.983	0.943	0.975	1.000	0.959	1.022
17	8.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.002
18	10.00	0.982	1.004	0.982	0.993	0.975	0.989	1.000	0.982	1.009
19	12.00	0.999	1.000	0.999	0.999	0.998	0.999	1.000	0.999	1.001
20	14.00	1.009	0.998	1.009	1.004	1.013	1.006	1.000	1.009	0.995
21	16.00	1.004	0.999	1.004	1.002	1.006	1.002	1.000	1.004	0.998
22	18.00	0.959	1.009	0.959	0.983	0.943	0.975	1.000	0.959	1.022
23	20.00	0.822	1.041	0.823	0.924	0.759	0.888	1.001	0.821	1.105
24	22.00	0.570	1.123	0.571	0.797	0.452	0.710	1.003	0.567	1.333
25	24.00	0.351	1.241	0.351	0.656	0.228	0.529	1.005	0.348	1.707

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2264, STATION 66 inches

MACH = 13.10 PO = 2250. psia TO = 2550. degF PTAVG = 1.67 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
13.10	0.905	93.6	7.53E-03	5.43E+05	6320.	2.10E-04	1.78E-02

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.345	1.245	0.346	0.651	0.223	0.523	1.005	0.342	1.721
2	-22.00	0.518	1.146	0.518	0.767	0.395	0.670	1.003	0.515	1.400
3	-20.00	0.751	1.061	0.751	0.891	0.667	0.840	1.002	0.749	1.158
4	-18.00	0.971	1.006	0.971	0.988	0.959	0.982	1.000	0.971	1.015
5	-16.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6	-14.00	0.956	1.009	0.956	0.982	0.938	0.973	1.000	0.955	1.023
7	-12.00	0.940	1.013	0.940	0.975	0.917	0.963	1.000	0.940	1.032
8	-10.00	0.929	1.015	0.929	0.971	0.901	0.956	1.000	0.928	1.039
9	-8.00	0.910	1.020	0.910	0.962	0.875	0.944	1.001	0.909	1.050
10	-6.00	0.931	1.015	0.931	0.972	0.904	0.958	1.000	0.931	1.037
11	-4.00	0.945	1.012	0.945	0.977	0.922	0.966	1.000	0.944	1.030
12	-2.00	0.948	1.011	0.948	0.979	0.927	0.968	1.000	0.948	1.028
13	0.00	0.926	1.016	0.926	0.969	0.897	0.954	1.000	0.925	1.040
14	2.00	0.934	1.014	0.934	0.973	0.908	0.959	1.000	0.933	1.036
15	4.00	0.950	1.011	0.950	0.979	0.930	0.969	1.000	0.949	1.027
16	6.00	0.938	1.013	0.938	0.974	0.913	0.962	1.000	0.937	1.033
17	8.00	0.936	1.014	0.936	0.973	0.910	0.960	1.000	0.935	1.035
18	10.00	0.938	1.013	0.938	0.974	0.913	0.962	1.000	0.937	1.033
19	12.00	0.949	1.011	0.949	0.979	0.929	0.969	1.000	0.949	1.027
20	14.00	0.957	1.009	0.957	0.982	0.940	0.974	1.000	0.957	1.023
21	16.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
22	18.00	0.980	1.004	0.980	0.992	0.972	0.988	1.000	0.980	1.010
23	20.00	0.768	1.056	0.768	0.899	0.688	0.851	1.001	0.766	1.145
24	22.00	0.535	1.138	0.535	0.777	0.413	0.683	1.003	0.532	1.377
25	24.00	0.349	1.243	0.350	0.654	0.226	0.527	1.005	0.346	1.712

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2265, STATION 66 inches

MACH = 13.70 PO = 9250. psia TO = 2700. degF PTAVG = 5.96 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
13.70	3.234	92.8	2.46E-02	1.88E+06	6583.	6.91E-04	1.00E-02

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.471	1.168	0.472	0.738	0.346	0.632	1.003	0.468	1.469
2	-22.00	0.677	1.084	0.677	0.854	0.577	0.789	1.002	0.675	1.221
3	-20.00	0.893	1.024	0.893	0.955	0.853	0.934	1.001	0.892	1.059
4	-18.00	0.983	1.004	0.983	0.993	0.976	0.990	1.000	0.983	1.009
5	-16.00	0.994	1.001	0.994	0.998	0.992	0.996	1.000	0.994	1.003
6	-14.00	0.982	1.004	0.982	0.993	0.975	0.989	1.000	0.982	1.009
7	-12.00	0.971	1.006	0.971	0.988	0.960	0.982	1.000	0.971	1.015
8	-10.00	0.970	1.006	0.970	0.988	0.958	0.982	1.000	0.970	1.016
9	-8.00	0.945	1.012	0.945	0.977	0.923	0.966	1.000	0.945	1.029
10	-6.00	0.953	1.010	0.953	0.981	0.934	0.971	1.000	0.952	1.025
11	-4.00	0.961	1.008	0.961	0.984	0.945	0.976	1.000	0.960	1.021
12	-2.00	0.988	1.003	0.988	0.995	0.982	0.992	1.000	0.987	1.006
13	0.00	0.990	1.002	0.990	0.996	0.987	0.994	1.000	0.990	1.005
14	2.00	0.993	1.001	0.993	0.997	0.991	0.996	1.000	0.993	1.003
15	4.00	0.962	1.008	0.962	0.985	0.947	0.977	1.000	0.962	1.020
16	6.00	0.964	1.008	0.964	0.985	0.949	0.978	1.000	0.963	1.019
17	8.00	0.966	1.007	0.966	0.986	0.952	0.979	1.000	0.965	1.018
18	10.00	0.980	1.004	0.980	0.992	0.972	0.988	1.000	0.980	1.010
19	12.00	0.976	1.005	0.976	0.990	0.967	0.986	1.000	0.976	1.012
20	14.00	1.010	0.998	1.010	1.004	1.015	1.006	1.000	1.010	0.995
21	16.00	1.006	0.999	1.006	1.002	1.008	1.004	1.000	1.006	0.997
22	18.00	0.998	1.000	0.998	0.999	0.998	0.999	1.000	0.998	1.001
23	20.00	0.916	1.018	0.916	0.965	0.883	0.948	1.000	0.915	1.046
24	22.00	0.702	1.076	0.702	0.867	0.607	0.806	1.002	0.700	1.198
25	24.00	0.475	1.166	0.475	0.740	0.349	0.635	1.003	0.472	1.463

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2266, STATION 24 inches

MACH = 14.25 PO = 19500. psia TO = 2680. degF PTAVG = 11.87 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
14.25	6.442	88.6	4.53E-02	3.85E+06	6689.	1.33E-03	7.26E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.568	1.124	0.568	0.796	0.450	0.708	1.003	0.565	1.335
2	-22.00	0.784	1.051	0.784	0.907	0.709	0.862	1.001	0.783	1.132
3	-20.00	0.955	1.010	0.955	0.981	0.936	0.972	1.000	0.954	1.024
4	-18.00	1.001	1.000	1.001	1.000	1.001	1.001	1.000	1.001	1.000
5	-16.00	1.002	1.000	1.002	1.001	1.002	1.001	1.000	1.002	0.999
6	-14.00	0.997	1.001	0.997	0.999	0.996	0.998	1.000	0.997	1.001
7	-12.00	0.997	1.001	0.997	0.999	0.996	0.998	1.000	0.997	1.001
8	-10.00	0.998	1.000	0.998	0.999	0.998	0.999	1.000	0.998	1.001
9	-8.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	-6.00	0.992	1.002	0.992	0.997	0.988	0.995	1.000	0.991	1.004
11	-4.00	0.959	1.009	0.959	0.983	0.942	0.975	1.000	0.958	1.022
12	-2.00	0.952	1.010	0.952	0.980	0.933	0.970	1.000	0.952	1.025
13	0.00	0.918	1.018	0.918	0.966	0.887	0.949	1.000	0.918	1.045
14	2.00	0.929	1.015	0.929	0.971	0.901	0.956	1.000	0.929	1.038
15	4.00	0.951	1.010	0.951	0.980	0.932	0.970	1.000	0.951	1.026
16	6.00	0.983	1.004	0.983	0.993	0.976	0.990	1.000	0.983	1.009
17	8.00	1.005	0.999	1.005	1.002	1.007	1.003	1.000	1.005	0.997
18	10.00	1.016	0.997	1.016	1.006	1.023	1.010	1.000	1.016	0.992
19	12.00	1.001	1.000	1.001	1.000	1.001	1.001	1.000	1.001	1.000
20	14.00	0.996	1.001	0.996	0.998	0.994	0.997	1.000	0.996	1.002
21	16.00	0.998	1.000	0.998	0.999	0.998	0.999	1.000	0.998	1.001
22	18.00	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
23	20.00	0.956	1.009	0.956	0.982	0.939	0.973	1.000	0.956	1.023
24	22.00	0.812	1.044	0.812	0.919	0.745	0.881	1.001	0.810	1.113
25	24.00	0.575	1.121	0.575	0.800	0.458	0.714	1.002	0.572	1.326

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2267, STATION 24 inches

MACH = 13.70 P0 = 8750. psia T0 = 2500. degF PTAVG = 5.79 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
13.70	3.139	86.4	2.39E-02	2.03E+06	6350.	7.21E-04	9.63E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.482	1.162	0.483	0.745	0.357	0.642	1.003	0.479	1.451
2	-22.00	0.695	1.078	0.695	0.863	0.598	0.801	1.002	0.693	1.204
3	-20.00	0.897	1.023	0.898	0.957	0.858	0.936	1.001	0.897	1.057
4	-18.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.002
5	-16.00	0.995	1.001	0.995	0.998	0.993	0.997	1.000	0.995	1.003
6	-14.00	0.985	1.003	0.985	0.994	0.979	0.991	1.000	0.985	1.008
7	-12.00	0.989	1.002	0.989	0.996	0.985	0.993	1.000	0.989	1.006
8	-10.00	0.990	1.002	0.990	0.996	0.986	0.994	1.000	0.990	1.005
9	-8.00	0.982	1.004	0.982	0.992	0.974	0.989	1.000	0.981	1.010
10	-6.00	0.983	1.004	0.983	0.993	0.976	0.990	1.000	0.983	1.009
11	-4.00	0.960	1.009	0.960	0.984	0.944	0.975	1.000	0.959	1.021
12	-2.00	0.957	1.009	0.957	0.982	0.939	0.973	1.000	0.956	1.023
13	0.00	0.905	1.021	0.905	0.960	0.868	0.941	1.001	0.904	1.053
14	2.00	0.927	1.016	0.927	0.970	0.898	0.955	1.000	0.926	1.040
15	4.00	0.957	1.009	0.957	0.982	0.939	0.973	1.000	0.956	1.023
16	6.00	0.976	1.005	0.977	0.990	0.967	0.986	1.000	0.976	1.012
17	8.00	0.987	1.003	0.987	0.995	0.982	0.992	1.000	0.987	1.007
18	10.00	1.009	0.998	1.009	1.004	1.013	1.006	1.000	1.009	0.995
19	12.00	1.006	0.999	1.006	1.003	1.009	1.004	1.000	1.006	0.997
20	14.00	0.996	1.001	0.996	0.998	0.994	0.997	1.000	0.995	1.002
21	16.00	1.005	0.999	1.005	1.002	1.007	1.003	1.000	1.005	0.997
22	18.00	1.014	0.997	1.014	1.005	1.019	1.008	1.000	1.014	0.993
23	20.00	0.917	1.018	0.917	0.966	0.885	0.949	1.000	0.916	1.045
24	22.00	0.713	1.072	0.714	0.873	0.621	0.814	1.002	0.711	1.189
25	24.00	0.482	1.162	0.483	0.745	C.357	0.642	1.003	0.479	1.451

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2268, STATION 108 inches

MACH = 14.35   PO = 20000. psia   TO = 2700. degF   PTAVG = 11.82 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
14.35	6.418	88.2	4.46E-02	3.84E+06	6718.	1.32E-03	7.32E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.583	1.118	0.583	0.804	0.467	0.720	1.002	0.580	1.317
2	-22.00	0.766	1.057	0.766	0.898	0.686	0.850	1.001	0.764	1.146
3	-20.00	0.901	1.022	0.901	0.959	0.863	0.938	1.001	0.900	1.055
4	-18.00	0.992	1.002	0.992	0.997	0.989	0.995	1.000	0.992	1.004
5	-16.00	1.009	0.998	1.009	1.004	1.013	1.005	1.000	1.009	0.995
6	-14.00	1.004	0.999	1.004	1.002	1.005	1.002	1.000	1.004	0.998
7	-12.00	0.978	1.005	0.978	0.991	0.968	0.986	1.000	0.977	1.012
8	-10.00	0.960	1.009	0.960	0.984	0.944	0.975	1.000	0.959	1.021
9	-8.00	0.960	1.009	0.960	0.984	0.944	0.975	1.000	0.959	1.021
10	-6.00	0.965	1.007	0.965	0.986	0.951	0.978	1.000	0.965	1.018
11	-4.00	0.978	1.005	0.978	0.991	0.968	0.986	1.000	0.977	1.012
12	-2.00	0.995	1.001	0.995	0.998	0.992	0.997	1.000	0.994	1.003
13	0.00	0.978	1.005	0.978	0.991	0.970	0.987	1.000	0.978	1.011
14	2.00	0.981	1.004	0.981	0.992	0.973	0.988	1.000	0.981	1.010
15	4.00	0.998	1.000	0.998	0.999	0.997	0.999	1.000	0.998	1.001
16	6.00	0.973	1.006	0.973	0.989	0.961	0.983	1.000	0.972	1.014
17	8.00	0.967	1.007	0.967	0.987	0.954	0.980	1.000	0.967	1.017
18	10.00	0.962	1.008	0.962	0.985	0.947	0.977	1.000	0.962	1.020
19	12.00	0.978	1.005	0.978	0.991	0.970	0.987	1.000	0.978	1.011
20	14.00	0.996	1.001	0.996	0.998	0.995	0.998	1.000	0.996	1.002
21	16.00	1.016	0.997	1.016	1.006	1.022	1.009	1.000	1.016	0.992
22	18.00	0.979	1.004	0.979	0.992	0.971	0.987	1.000	0.979	1.011
23	20.00	0.898	1.022	0.898	0.958	0.859	0.937	1.001	0.897	1.056
24	22.00	0.779	1.053	0.779	0.904	0.703	0.859	1.001	0.778	1.136
25	24.00	0.583	1.117	0.583	0.805	0.467	0.720	1.002	0.581	1.317

TUNNEL 9 FLOW UNIFORMITY CALIBRATION
WTR 1608, RUN 2269, STATION 108 inches

MACH = 13.68   PO = 9500. psia   TO = 2650. degF   PTAVG = 6.24 psia

NOMINAL FREESTREAM CONDITIONS

MACH	QINF psia	TINF degR	PINF psia	REINF 1/ft	UINF ft/sec	RHOINF lbm/ft3	VIP ft**1/2
13.68	3.389	91.7	2.59E-02	2.01E+06	6530.	7.36E-04	9.65E-03

PROFILES NORMALIZED TO NOMINAL

Probe #	Dist. from center (in)	PT	M	Q	T	P	RE	U	RHO	VIP
1	-24.00	0.494	1.157	0.494	0.752	0.369	0.651	1.003	0.491	1.434
2	-22.00	0.667	1.087	0.667	0.849	0.565	0.782	1.002	0.665	1.230
3	-20.00	0.860	1.032	0.860	0.941	0.807	0.912	1.001	0.858	1.081
4	-18.00	0.979	1.004	0.979	0.992	0.971	0.987	1.000	0.979	1.011
5	-16.00	0.999	1.000	0.999	1.000	0.998	0.999	1.000	0.999	1.001
6	-14.00	0.980	1.004	0.980	0.992	0.971	0.988	1.000	0.97[illegible]	1.011
7	-12.00	0.962	1.008	0.962	0.984	0.947	0.977	1.000	0.962	1.020
8	-10.00	0.940	1.013	0.940	0.975	0.917	0.963	1.000	0.940	1.032
9	-8.00	0.939	1.013	0.939	0.975	0.915	0.962	1.000	0.939	1.033
10	-6.00	0.950	1.011	0.950	0.980	0.930	0.969	1.000	0.950	1.026
11	-4.00	0.960	1.009	0.960	0.983	0.943	0.975	1.000	0.959	1.021
12	-2.00	0.965	1.007	0.965	0.986	0.951	0.978	1.000	0.965	1.018
13	0.00	0.942	1.012	0.942	0.976	0.919	0.964	1.000	0.941	1.031
14	2.00	0.958	1.009	0.958	0.983	0.941	0.974	1.000	0.957	1.022
15	4.00	0.982	1.004	0.982	0.993	0.974	0.989	1.000	0.982	1.009
16	6.00	0.961	1.008	0.961	0.984	0.946	0.976	1.000	0.961	1.020
17	8.00	0.953	1.010	0.953	0.981	0.935	0.971	1.000	0.953	1.025
18	10.00	0.952	1.010	0.952	0.980	0.933	0.971	1.000	0.952	1.025
19	12.00	0.970	1.006	0.970	0.988	0.958	0.982	1.000	0.970	1.016
20	14.00	0.981	1.004	0.981	0.992	0.974	0.989	1.000	0.981	1.010
21	16.00	1.001	1.000	1.001	1.000	1.002	1.001	1.000	1.001	0.999
22	18.00	0.991	1.002	0.991	0.996	0.987	0.994	1.000	0.990	1.005
23	20.00	0.878	1.027	0.879	0.949	0.833	0.924	1.001	0.877	1.069
24	22.00	0.692	1.079	0.692	0.862	0.594	0.799	1.002	0.689	1.208
25	24.00	0.493	1.157	0.493	0.752	0.368	0.650	1.003	0.490	1.436

DISTRIBUTION

	Copies
DOD ACTIVITIES (CONUS)	
DEFENSE TECHNICAL INFORMATION CENTER CAMERON STATION ALEXANDRIA VA 22304-6145	12
ATTN CODE E29L COASTAL SYSTEMS STATION DAHLGREN DIVISION NAVAL SURFACE WARFARE CENTER 6703 WEST HIGHWAY 98 PANAMA CITY FL 32407-7001	4
NON-DOD ACTIVITIES	
ATTN GIFT AND EXCHANGE DIV LIBRARY OF CONGRESS WASHINGTON DC 20540	4
CENTER FOR NAVAL ANALYSES 4401 FORD AVENUE ALEXANDRIA VA 22302-0268	1
NATIONAL AEROSPACE PLANE JOINT PROGRAM OFFICE WRIGHT PATTERSON AFB OH 45433	1
INTERNAL	
E231	2
E232	3
K24	1
K24 (D MARREN)	1

REPORT DOCUMENTATION PAGE		Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	31 January 1994	

4. TITLE AND SUBTITLE
Hypervelocity Tunnel 9 Mach 10/14 Calibration

5. FUNDING NUMBERS

6. AUTHOR(S)
Dan Marren

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Surface Warfare Center (Code K24)
10901 New Hampshire Avenue
Silver Spring, MD 20903-5640

8. PERFORMING ORGANIZATION REPORT NUMBER
NSWCDD/TR-92/160

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This report documents the Tunnel 9 Mach 10/14 Calibration test program (WTR 1608) performed at the Naval Surface Warfare Center, White Oak, Maryland. This effort was sponsored by the National Aerospace Plane Joint Program Office (NASP JPO). Free stream flow field parameter distributions were obtained for both the Mach 10 and 14 nozzles spanning the Reynolds number range. A total of four Mach 10, and ten Mach 14 runs were performed during this test program. The test period was 7 to 22 May 1991. Results from this test entry were combined with previous test data in the final analysis. Data from the test reveal that high quality uniform flow exists and that deviations in core flow field parameters are comparable with the calibration data taken in the past.

14. SUBJECT TERMS
Hypervelocity Wind Tunnel
Uniformity Calibration

15. NUMBER OF PAGES
66

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and its title page. Instructions for filling in each block of the form follow. It is important to ***stay within the lines*** to meet ***optical scanning requirements***.

Block 1. Agency Use Only *(Leave blank)*.

Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C	- Contract	PR	- Project
G	- Grant	TA	- Task
PE	- Program Element	WU	- Work Unit Accession No.

BLOCK 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

Block 10. Sponsoring/Monitoring Agency Report Number. *(If Known)*

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of...; To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD	- See DoDD 5230.24, "Distribution Statements on Technical Documents."
DOE	- See authorities.
NASA	- See Handbook NHB 2200.2
NTIS	- Leave blank.

Block 12b. Distribution Code.

DOD	- Leave blank.
DOE	- Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.
NASA	- Leave blank.
NTIS	- Leave blank.

Block 13. Abstract. Include a brief ***(Maximum 200 words)*** factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code ***(NTIS only)***

Blocks 17.-19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.